ISASC

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Cover Picture

This British postal scale was made when the lowest rate was 1oz, that is between 1871 and 1897. If a letter of under 1oz was put on to it, the poise did not lift, and a penny stamp was sufficient. If a heavier letter was put on, the poise lifted and the user probably took the letter to the Post Office to ascertain what stamp was needed. Because the maker's name is not yet known, the scales of this design are said to be by "the Ball and Rod" maker. This maker loved variety with his ball and rod. Pillars varied, beams varied, poise-shape varied, bases varied, or the rod was sometimes replaced by a chain. Most were made of patinated brass, most had end fittings permanently attached to the beam (but not always), most had gold or polished brass high-lights, most had the poise held in an "egg-cup". They were all about 5 inches high, and most had beams about 5 inches long. Rare examples had interchangeable poises or additional slotted poises. This example is unusually light, with a relatively insubstantial beam and a light letter-hanger of sheet brass. The base is made of ebonised wood, with a cast-brass trim ornamented with scrolls. It is 4 7/8ins. (124mm) high, and the beam is only 3 3/4ins (95mm) long.

Editorial note: The editorial board apologises to all readers for the incompatibility of the computers used by the editors and the printer. The symbols for fractions do not translate, and the last issue contained many examples of fractions turning into "fi" (instead of a half) and "/" (instead of a quarter).

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Presidential Coin Scales

BY GARY BATZ

The first three presidents of the United States lived in a period of currency confusion, one in which coin scales were essential equipment.

In the late 18th century, the gold and silver of many kingdoms filled the gap created by a chronic scarcity of British coins in the American colonies. Jefferson's *Memorandum Books* reveal that he loaded friends bound for England with precious metal of all shapes and nationalities. In 1769 he handed Matthew Maury[1] three gold Portuguese half Johannes (joes), two German gold ducats, and a silver coffeepot weighing twenty-two ounces. A year later, one of Jefferson's most troublesome legal clients finally paid him in a motley mixture of silver and gold; gold half joes and moidores from Portugal, gold doubloons and pistoles from Spain, and 308 English silver half crowns.

To compound the disorder of the situation, almost every colony had its own rates of exchange. On crossing the border from Virginia to Maryland in 1775, Jefferson had to note in his *Memorandum Book* the new values of Spanish dollars and pistareens, and of Portuguese half joes as well as the new values of English guineas and shillings. In 1781, moidores, worth 1 pound and 7 shillings in London, were valued at 2 pounds 5 shillings in Philadelphia, while they were worth 3 more shillings in New York. Half Johannes worth 1 pound 16 shillings in London were reckoned at 3 pounds in Philadelphia and 8 more shillings in New York. Doubloons, the Spanish 8 escudo pieces, valued at 3 pounds and 6 shillings in London, were worth 5 pounds and 12 shillings in Philadelphia. Even for the astute Jefferson, a purely British system would have been an ordeal.

Jefferson began advocating decimal reckoning as an orderly alternative to the currency chaos in

Money SCALES and WEIGHTS, of all Kinds fold by WILLIAM POYNTELL, IN PHILADELPHIA.

	Sterling £	s	d.	Philad. £.	s.	d.	N.York. £.	s.	d.	Wt. dwt.	gr.
ENgl. Guineas, at	1	1	0	1	15	0	1	17	0	5	6
French ditto ..	1	1	0	1	14	6	1	16	0	5	4
Moidores	1	7	0	2	5	0	2	8	0	6	18
Johannes's	3	12	0	6	0	0	6	8	0	18	0
Half ditto	1	16	0	3	0	0	3	4	0	9	0
French milled Piſtoles	0	16	0	1	7	6	1	8	0	4	4
Spaniſh ditto	0	16	6	1	8	0	1	9	0	4	5
Doubloons	3	6	0	5	12	0	5	16	0	16	20
Engliſh Crowns	0	5	0	0	8	4	0	8	9	19	0
French ditto	0	5	0	0	8	4	0	8	6	19	0
Spaniſh Dollars ..	0	4	6	0	7	6	0	8	0	17	6
Engliſh Six-pence ..	0	0	6	0	0	10	0	0	10½		

All *GOLD* of equal fineneſs, with the Coins here mentioned, is taken at the *Bank of North-America*, at 6/8 a Penny-Weight.

Fig. 1. ⅄⅄ William Poyntell, Importer in Philadelphia This label and, presumably, a box of scales and weights, is believed to be at the United States Numismatic Collection at Washington, D.C.[2] The label dates between 1781 and 1784 when another, dated, label shows different values. The Bank of North America was incorporated in 1781 by an ordinance of the American Congress, and was the precursor of the Bank of the United States.[3]

1776. In 1784 after publishing his *Notes on the Establishments of a Money Unit*, he recommended a system with the advantages of convenience, simplicity, and familiarity. The Spanish dollar was convenient in size, its decimal division would make computation simple, and its multiples and subdivisions would accord with already well-known coins.

As Jefferson said, "Even mathematical heads feel the relief of an easier substituted for a more difficult process." Jefferson's lucid arguments overwhelmed rival plans and the United States soon became the first nation in history to adopt a decimal coinage system, by its *Coinage Act of April 2, 1792, establishing a Mint and regulating the coins of the United States*.[4]

One naturally wonders what coin scales the early presidents used to help them through the confusion of the period.

George Washington

The American President George Washington (1732-1799) wrote in his diary, "a man must travel with a pair of scales in his pocket, or run the risk of receiving gold at one-fourth less by weight than it counts".[5] His *Household Account Book*,[6] under May 29 1793, indicates "President's Account proper paid for a pair of scales sent to Mount Vernon $12.98." And the following day: "The President's Account proper paid for weights sent to Mount Vernon $1.60."

Perhaps William Poyntell was the supplier of Washington's coin scales. He is known through a label in a box of scales and weights from Philadelphia, Fig. 1. Poyntell must have had a diversified import business. Washington bought from him "34 p[ac]k[age]s paper &c. for $21.60." Further reading in Washington's *Household Account Book* of October 19 and November 15 1794 reveals that this was wall-paper, as he also paid $17.45 to "Thomas Vizer for papering entry".[7] But it does not reveal whether Washington's scales and weights came from Poyntell's shop.[8]

John Adams

John Adams (1735-1826) was vice-president during Washington's first tenure as president; he became America's second president. I discovered his coin scales in the Henry Ford Museum at Dearborn, Michigan. The museum staff showed me a carton holding two oval japanned boxes of the type made in England around 1785. With them was a typewritten letter, probably a copy of an original handwritten note, Fig. 2.

The scale boxes have these dimensions L 129mm, W 55mm, H 18mm. ($5^{1}/_{16}$ x $2^{1}/_{8}$ x $^{3}/_{4}$ins.) Unfortunately, the museum staff could not connect the letter to either of the boxes and scales. [Editor - see Fig. 3, an example of an oval-japanned box.]

Thomas Jefferson

Thomas Jefferson, (1743 - 1826), the third president of the Unites States, had a coin scale.[9] It is on show at the Visitor Center near his mountain-top home, Monticello, at Charlottesville, Virginia.[10] Jefferson's assets, which had been dispersed after his death, have been returned to Monticello, by gift, purchase and loan so that the Foundation can state with some confidence and pride that they have about 25% of what Jefferson had owned.

Monticello now has four scales for the weighing of coins, two folding scales and two equal-arm scales. The larger of the two folders is at the Visitor Center where it is part of a display of 400

HARRY FLAYDERMAN
ANTIQUES
44 CHARLES STREET
BOSTON

This is to certify, May 1, 1937, that I, Effie Alexander Nowell, am a member of the Badlam family and that the pair of silver shoe buckles were made for and owned by Stephen Badlam and also that the box and scales were owned by Stephen Badlam and obtained by him from John Adams, President of the Unites States.

Effie Alexander Nowell
.....85 St. James Ave., Boston

Fig. 2. ⩚⩚ Which set of scales did Adams originally own?
Certificate courtesy of the Henry Ford Museum & Greenfield Village, Dearborn, Michigan.[11]

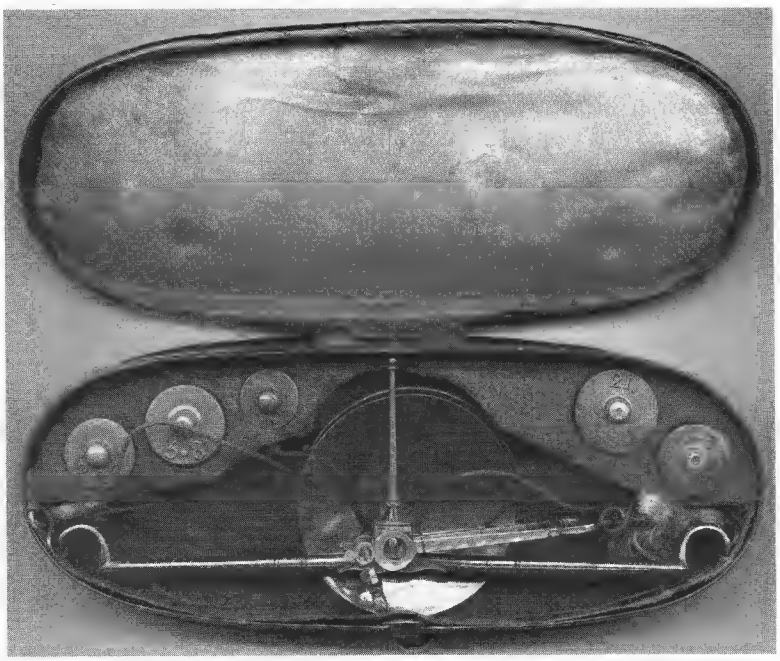


Fig. 3. ⩚⩚ John Adams owned scales (see Fig. 2) and the Henry Ford Museum has two sets in oval-japanned boxes, one of which could have been his. Unfortunately, the museum staff could not connect the letter to either of the boxes of scales. We have no picture of those sets, and such boxes vary greatly in lay-out and facilities, the feature in common being the very high quality of the contents. To give some idea of the type, this set (from another collection) is shown. See endnote 12. Photo courtesy D Hitchins

objects once belonging to Jefferson. It bears a paper label stating

A. WILKINSON, Ormskirk
Late of KIRKBY
Near LIVERPOOL

Made of mahogany, the box has the dimensions: L 136mm, W 25mm, H (not given). ($5^3/8$ x 1 x probably $^9/16$ins.) See the larger folder in Fig. 4. According to the Foundation's notes, [13]this scale is presumed to have been bought by Jefferson on his visit to England in 1786 and used by him.",

The smaller folding coin scale also bears a paper label, inside the case, with the same address.[14] It is presumed to have been used at Monticello and inherited by Martha Jefferson Randolph upon her father's death. It descended further in her family until sold at auction in 1940 to a purchaser who in turn sold the scale to the current lender. Its dimensions are L 92mm, W 13mm, and H 9mm. ($3^5/8$ x $^1/2$ x $^3/8$ins.) See the front folder in Fig. 4.

Folders like this one generally have a small sliding poise that moves across the weighing beam, which is marked at intervals with 0, 3, 6 and 9, giving the value in pennies (or pence, correctly) that the gold coin was lacking in mass. To an American using an English-made scale, this presented another currency conversion problem. While standard gold in England was reckoned at £3.17.$10^1/2$ per ounce (or, for convenience, 2 pence per grain), Mr. Poyntell would be paying 6 shillings 8 pence per penny-weight (or $3^1/3$ pence per grain).[15]

Folders had a limited purpose: normally, before 1797, they were only to weigh single guineas and half guineas, as the range of weighing was predetermined. The normal user could not adapt them to weigh other coins, whether gold or silver.

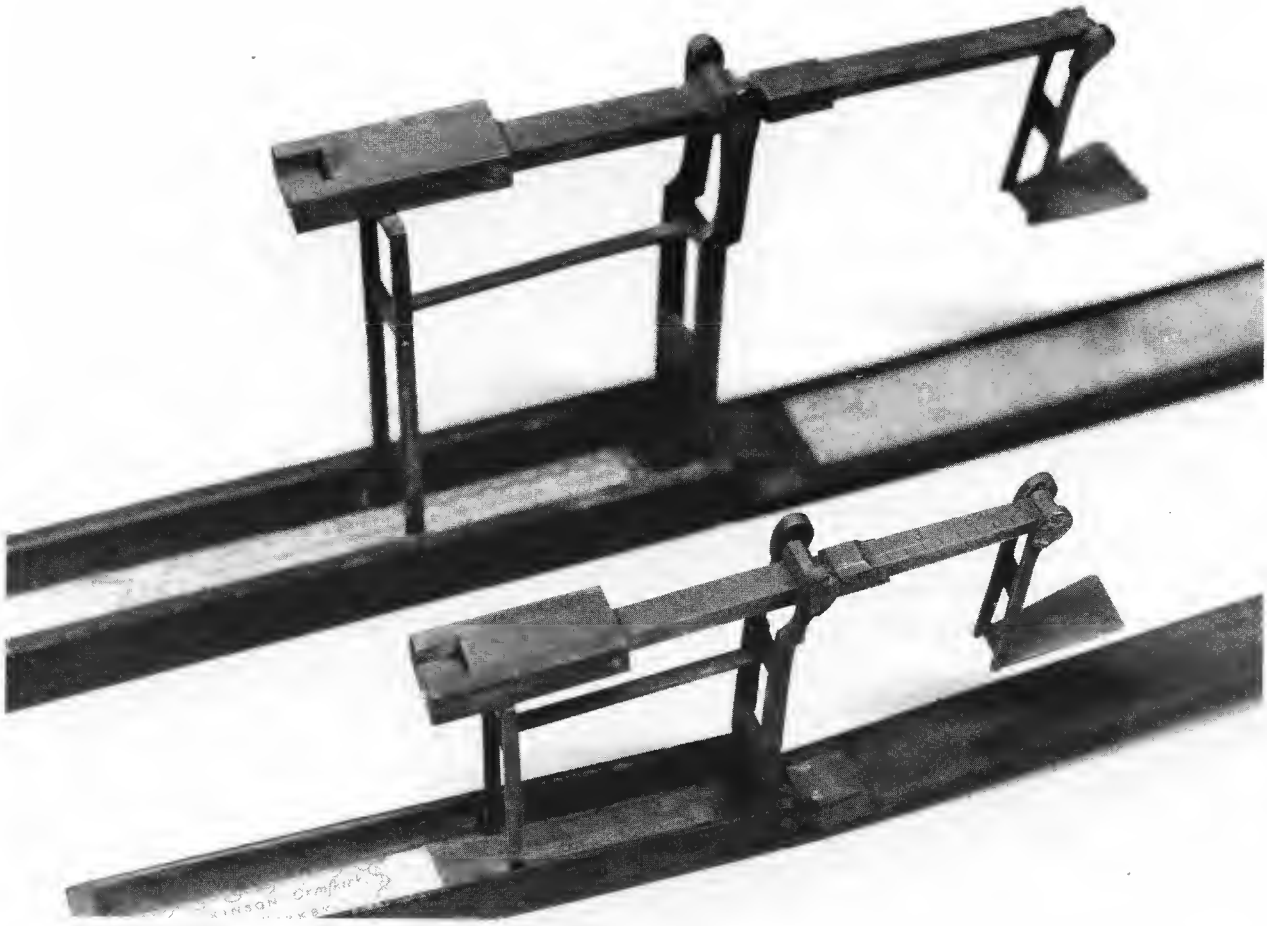


Fig. 4. ⩚⩚ Thomas Jefferson had two Wilkinson folders, one standard size and one miniature. Having no photograph of them, two similar ones are shown here. See Note 16. Photo courtesy the late M A Crawforth

Anthony Wilkinson, the scale maker, was born about 1732. He was assessed for land taxes in Kirkby from 1781 to 1785. He moved his business to Ormskirk in 1786 and died in 1801. He claimed to have been the inventor of the folding gold balance. Although some labels claimed a patent, there is no record of one. However, his claim as the inventor has so far not been disproved.

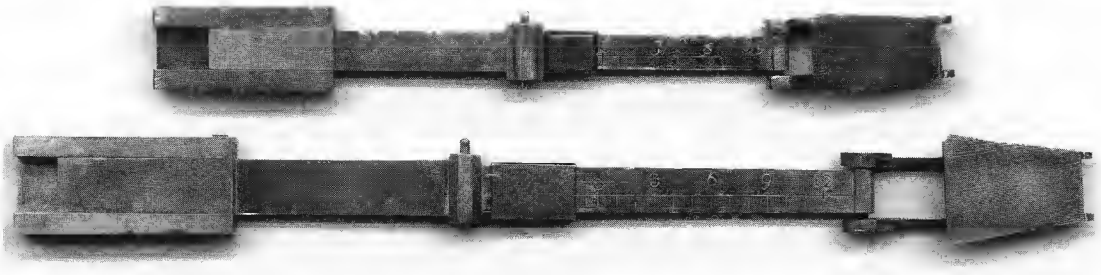


Fig. 5. ⩚⩚ Beam from an ordinary A Wilkinson folder at the bottom, showing the slide on the right of the fulcrum. If the coin did not tip the beam until the plate touched the open lid, the slide was moved along until it did. Then the pennies to be deducted could be read off. The beam at the top comes from another miniature folder by A Wilkinson, this one adapted after 1817 to weigh the sovereign and its half. Full size. Photo courtesy D Hitchins

He seems to have had the largest output of folders; one fourth of all known balances still extant in England were made by Wilkinson.

Miniature folders are rare. The late Michael A Crawforth recorded that he saw but 6 small ones among 182 Wilkinson scales, and thirteen similar miniatures, made by three other makers. To give some idea of price, Wilkinson folders were available in all larger market towns, and Jefferson may have paid six shillings.[17]

Fig. 6. ⩓⩓ Young & Son of London. The third Monticello scales that belonged to Thomas Jefferson. Gary Batz' photo courtesy of the Thomas Jefferson Memorial Foundation.

The third Monticello scales (and probably the fourth, equal-arm scales) were made by Young and Son of 5 Bear Street, Leicester Fields (later Leicester Square), London, in or after 1811. The War of 1812 may have stopped merchandise from going to America for two years or more; hence there is uncertainty about a date of purchase by Jefferson. The third scale comes in an oaken "made-up box", dimensions L 176mm, W 87mm, H 32mm. The beam is 124mm (4⁷/₈ins) in length, is of circular tapering shape; it has swan-neck ends, a cupid's bow beneath, and a pendant holding the shears together. At the top of the shears is a bushy, brown silk tuft by which to grasp the scales. The pans measure 51mm in diameter, being the usual 2 inch pans used for the weighing of silver coins.

The inside lid of the box has a printed paper label, in three sections. See Fig. 7. The bottom of the box once was lined with green baize, of which remnants can be seen; there is no evidence of former weight pens, usually in the front of the box bottom, or elsewhere, nor are there any weights in the box. The box has plain iron wire hinges and a brass hook and eye on top. To weigh coins, the weights would have consisted of troy ounce weights, a set of pennyweights from 1 to 6, and a set of grain weights made of brass sheet metal.[18]

Young & Son

SCALE MAKERS
TO HIS MAJESTY,
No. 5, Bear Street,
Leicester Square,
London.

Make & Sell all sorts of
Scales, Weights & Steel-yards,
for Home Trade & Exportation

[Royal Coat of Arms with supporters][19]
[Hand and Scales, the sign outside the shop, with flat round weights between the scale-pans]

Shopkeeper's Scales kept in Repair by the Year

Avoirdupois Weight
16 Drachms make..1oz.
16 Ounces .....1lb.
Troy Weight
24 Grains make...1 dwt.
20 Pennyweights....1oz.
12 Ounces.....1lb.
Apothecaries Weight
20 Grains make.....1 scrup.
3 Scruples.....1 Drachm
8 Drachms.....1 oz.
12 Ounces.....1 lb.

Fig. 7 ⩓⩓ A typed copy of the label in the Young & Son box. Drams or drachms were two ways of spelling the same word.

The fourth beam is virtually identical to the one just described, but it lacks a box. See Fig. 8. Jefferson could have bought it as a second or spare set of scales, considering that replacements would be weeks, if not months, away in far-off London, provided the demand arose in the spring or fall shipping seasons. This beam has a similarly interesting provenance and was once owned by a niece of the wife of United States President Andrew Jackson.[20]

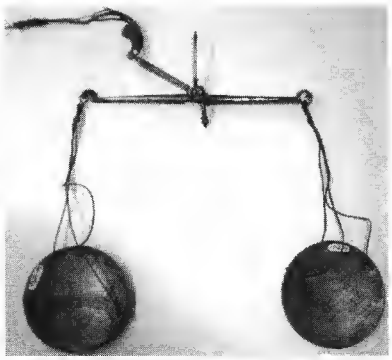


Fig. 8. The fourth beam at Monticello. Gary Batz' photo courtesy of the Thomas Jefferson Memorial Foundation.

What follows is the story of one of the longest-lasting scale-making dynasties. It started with George Sewell, born around 1740. By 1756 he was apprenticed to Charles Sommers, a master scale-maker, and from there went on to John Wornell three years later. After learning with another master, Joseph Read, Sewell became a freeman in 1763. Ten years later, John Young became Sewell's apprentice. Meanwhile, Sewell and Bate became partners around 1780, after some 15 years in business for himself. From 1786-1801 Sewell and Young went into partnership. John Young's son of the same name and the younger George Young were apprenticed to Sewell and Young in 1799 and 1803, respectively. From 1802 until 1810, John Young was on his own. From 1811 to 1901(!) there existed the partnership called Young & Son, ending nearly 150 years of meritorious service in the field of scale-making.[21]

Jefferson's *Memorandum Books* contain surprisingly few references to the purchase of scales or steelyards. They and other records, however, are full of signs of the daily use of weighing devices. On the plantation there was constant weighing of wheat and cornmeal, hogs and beef, or nails made in the nailery. Jefferson himself used smaller scales to weigh his newborn daughter Lucy, a silver pot given in payment, a new pair of silk stockings and how much sugar he added to his coffee. Because coins had to be weighed to determine their value, Jefferson's specifications for a traveling box include "money scales" and "money steelyards" such as described above.[22]

Indeed, because of the fact that coins passed by weight (mass) and not by tale (count), all these presidents and others receiving gold or silver coins were dependent on their coin scales.

Notes & References

1. Matthew Maury was seeking books for Jefferson and ordination for himself in London.
2. I am grateful to Dr. G M M Houben who discovered this trade label around 1981 and has used it in a number of his publications. Upon reviewing its state of preservation, I decided to enlarge it, take out the damaged currency values, insert the correct ones and, generally, eliminate other irrelevant matter, smudges, etc.
3. Clark, S C M, & Hall, D A, *Legislative and Documentary History of the Bank of the United States including the original Bank of North America,* Washington, 1832.
4. Stanton, L C, Monticello Research Department. Condensed from an essay printed in the Newsletter *Monticello*, Vol. 5 (Summer 1994). Courtesy www..monticello.org/resources.
5. Sparks, J, editor, *The Writings of Washington*, ix. 125, Boston, 1855.
6. Washington's "Household Account Book 1793-1797," *Pennsylvania Magazine of History and Biography*, vol XXIX no. 4, The Historical Society of Pennsylvania, 1905.
7. Washington's "Household Account Book," 1793-1797, *Pennsylvania Magazine of History and Biography*, vol. XXXI, 322, The Historical Society of Pennsylvania, 1907.

8. Enquiries at Mount Vernon, Washington's home in Virginia, as to whether there are coin scales among the possessions, were left unanswered during the three months this article was in preparation.
9. I am grateful to Gloria and the late Ralph Lipfert for the information that Thomas Jefferson had a coin scale.
10. I want to thank Ms Kelly Fearnow of the Office of Development and Public Affairs of the Thomas Jefferson Memorial Foundation, Inc. (TJMF) for putting me in touch with Ms Carrie E. Taylor, the collections manager.
11. Copy of letter: courtesy Mr. R. E. Springer, Registrar, Henry Ford Museum & Greenfield Village, Dearborn, Michigan, August 17, 1989.
12. Editor - The lid is lined with a pink silk pad, plumped out with sheep's wool. The wooden block, drilled to take the weights, is covered with hand-cut red velvet. From the left, the weights are cast with 2.16, 5.8, 1.7, 21 and 10.6 respectively. The guinea weight on the right is exceptional, in that originally it had cast into it 1 1/2 -, now filed off, but the half-guinea still has 3/4 - cast into it. The subtractions are for 1 1/2 pennies and 3/4 penny respectively. The guinea weight of 21 is heavier than the 5.8 guinea weight on the left, that has an allowance of 2 pence. This suggests that the set was made before the Acts of Parliament of 1773-1775, after which, any guinea of more than 5.8 passed at its full value of 21s.
13. The larger of the Thomas Jefferson scales descended in the Trist-Burke families and was acquired in 1961 by TJMF. Most physical descriptions of the scales courtesy Carrie E. Taylor, Collections Manager, TJMF, data given me August 10, 2000.
14. The miniature folder is on loan to the Foundation and could not be photographed, but the staff kindly gave me a color slide.
15. Sheppard, T & Musham, J F, *Money Scales and Weights*, reprinted 1975, Spink and Son Ltd, scale 161.
16. Editor - These Wilkinson folding guinea balances are in the Bankfield Museum, Halifax, UK. The standard one at the rear is 2 7/8ins high, has graduated marks for 12 pennies deficiency, and has the normal tiny plate on which to place the coin, very carefully! There are full instructions for use. The miniature at the front is 2in. high, has graduated marks for 9 pennies deficiency and has a longer plate on which to place the coin. Care in placing the coin is still essential, but possibly the coin would not fall off quite so easily! There was no room to glue in the full instruction labels, so Wilkinson had a special abbreviated instruction sheet printed, just for miniature folders.
17. Crawforth, M A, *Weighing Coins, English folding gold balances of the 18th and 19th Centuries*, London, 1979.
18. The Young & Son scale descended in the family of Martha Jefferson Randolf until 1940 when it was bought by a purchaser whose daughter inherited several objects. The scales were sold to the Foundation in 1992 by Mrs. Ruth Horn Crownover.
19. Editor - Crawforth, M A, Evidence from Trade Cards for the Scientific Instrument Trade, *Annals of Science*, 42, (1985), p 537. Coats of Arms changed during the reigns of the various Hanoverians.
20. The loose scale beam was acquired by TJMF in 1958.
21. Data on the Sewell and Young dynasty: Courtesy D F Crawforth-Hitchins, Editor, from her own research data.
22. Stein, S R, *The Worlds of Thomas Jefferson at Monticello*, Thomas Jefferson Memorial Foundation Inc., 1993.

Biography

Gary Batz discovered coin weights on vacation in South Carolina in 1981. A coin dealer challenged him to dig up more information about an unknown item that he would sell him for $5. His lifelong love of history, his penchant for accuracy and numbers, and tenacity in solving problems soon led him to discover that he owned an English-made half moidore from about 1750. In the intervening years, his knowledge increased in all aspects of coin scales and weights, in several languages and many countries. Fortuitous discoveries of hitherto unpublished colonial American silver weights from New Amsterdam (New York) and Philadelphia have turned his efforts toward discovering more about the late 1600s and the early 1700s history of these cities and their appointments of "money adjusters" whose duties included the making of weights for the weighing of coined silver. With the help of ISASC member Eugene Mahoney, several articles about this fascinating part of early American history are in the offing. He is now in his 50th year of doing income tax returns for others, both Canadian and American.

Mesmerised by Sartorius

BY T ALLGEIER, P BUCHANAN, D CRAWFORTH-HITCHINS & B J OLIVER

What does a collector do when faced by the most beautiful balance ever seen? What do four collectors do when standing round the most beautiful balance and they can't see how to operate it? Resisting the desire to worship, they don white cotton gloves and gingerly attempt to move various handles. When nothing happens, and they believe that only by connecting up the electricity will they be able to operate the balance, they try to roll a shaft or two, just on the off-chance that

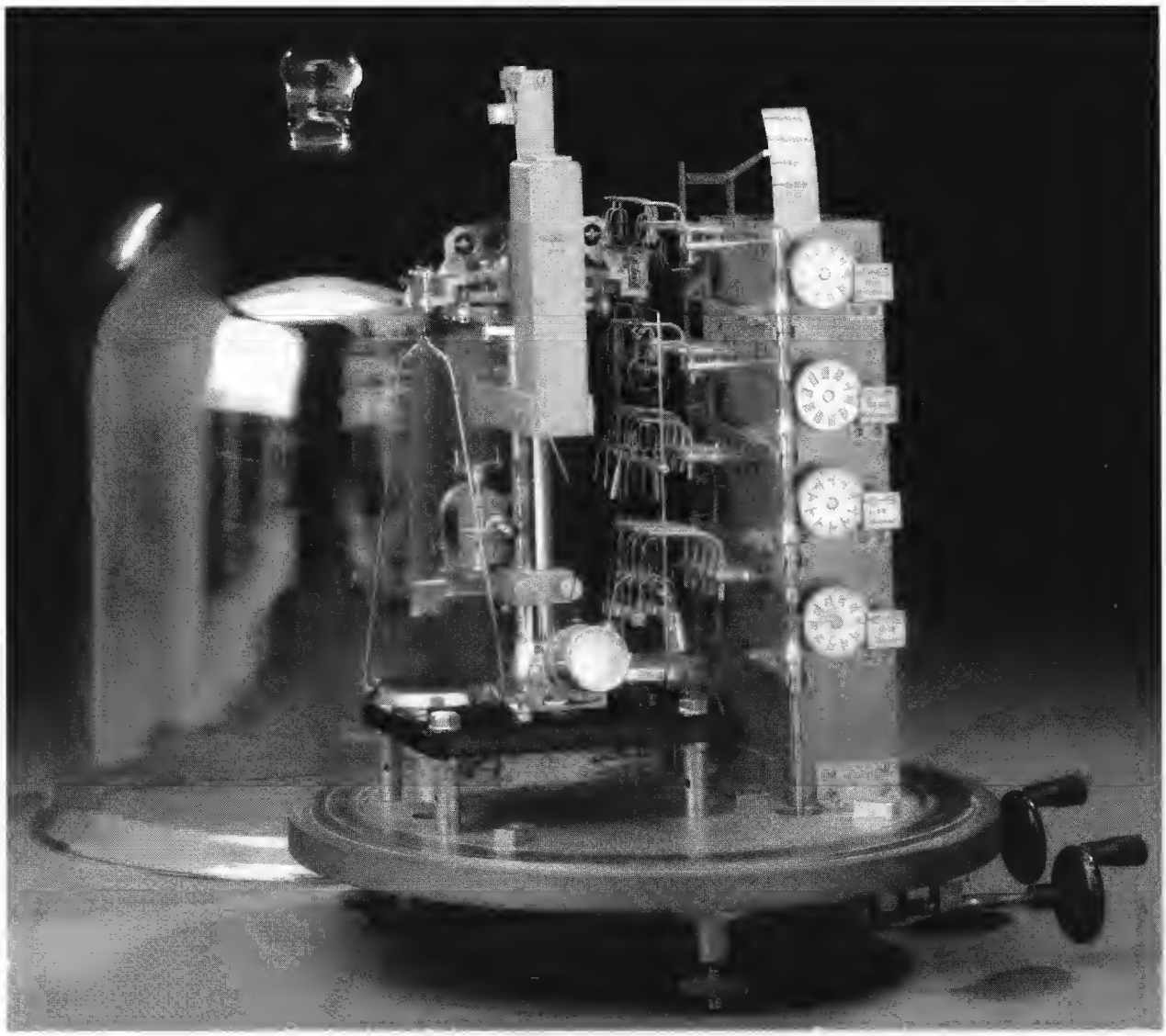


Fig. 1. ⍋⍋ The golden Vacua, c.1952, by Sartorius-Werke of Gottingen, height 600mm (24ins). The black handles on the right bring the electric power to the clutches under the base. The front black handle operates the arrestment. The rear black handle drives the coarsest bank of weights (tens of grams) to drop the weights onto the weight-bar until they are near to, but less than, the load, then it releases the second bank (single grams) to bring the weights even nearer to the weight of the load.then the third and fourth bank are dropped in sequence. To keep the weight-bar horizontal, the weights are deposited in an elaborate sequence to gradually build up to the maximum capacity of the bank keeping the eccentricity to a minimum. This is fascinating and slightly eerie, as if the balance is thinking! Photo courtesy Christie's South Kensington

Fig. 2. ⮝⮝ The trade-mark and serial number on the 'periscope' box.

something will move. The shafts rotate, discs revolve, cams shift and weights drop onto their bars. Magic!

It is impossible to describe completely the adventure that the team experienced in studying the Sartorius-Werke balance that is to be sold by Christie's South Kensington in April 2001. We were called in to explain the functions and to date this superb balance. Starting from a position of knowing and using the simpler British laboratory balances, we were charmed by this elaborate gilded balance sitting under its heavy glass dome like a valuable clock.

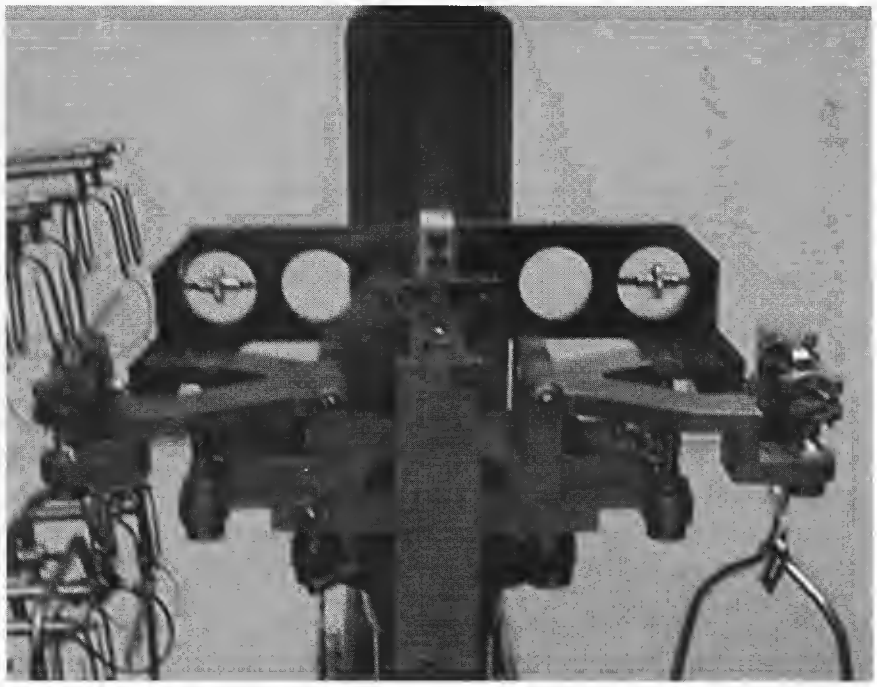


Fig. 3. ⮝⮝ Seen from the rear, the beam, 142mm long, with the circular cut-outs, the outer two having adjustment screws. Below the beam is the two-centre radial arrestment, which, in this picture, is not fully applied, leaving the beam slightly tipped. The aluminium strip screwed to the beam goes up to the magnetic damping mounted out of sight. The complex compensation hanger is clearly visible on the right. The top bank of ring weights (10-90mg) show on the left.
T Allgeier photo courtesy Christie's South Kensington

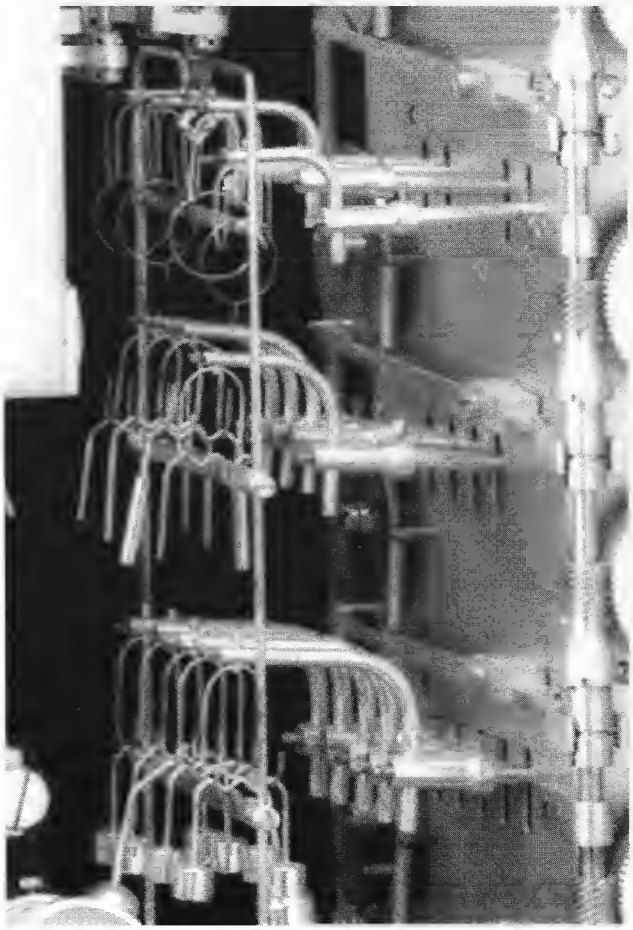


Fig. 4. ⮜⮜ Most of the bottom bank of weights (10-90grams) is visible, but the much bigger 50 gram weight is almost out of sight. The second bank up covers 1-9grams, and the third bank up covers 100-900mg. It is just possible to see the circular discs at the rear of each bank, that each have a cam on one edge that, when pushed, rock the arm coming towards the front shaft. The arm has a pin that slots into the shaft at the front. As the shaft revolves the indication-discs, almost out of sight on the right, turn to indicate the weights accumulated. The gradual movement of all these interconnected parts was engrossing.
Photo courtesy Christie's South Kensington

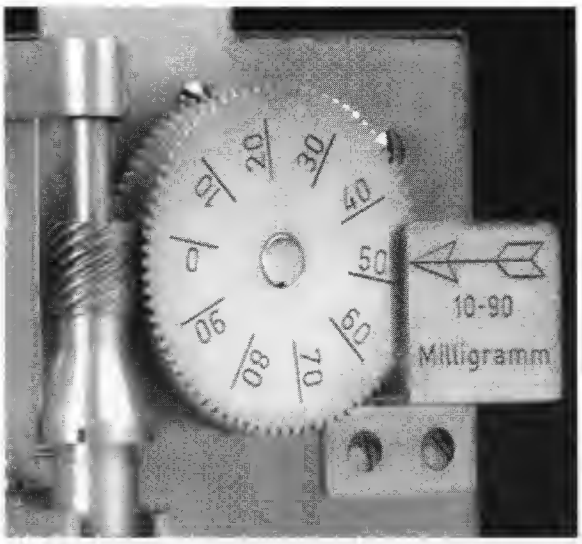
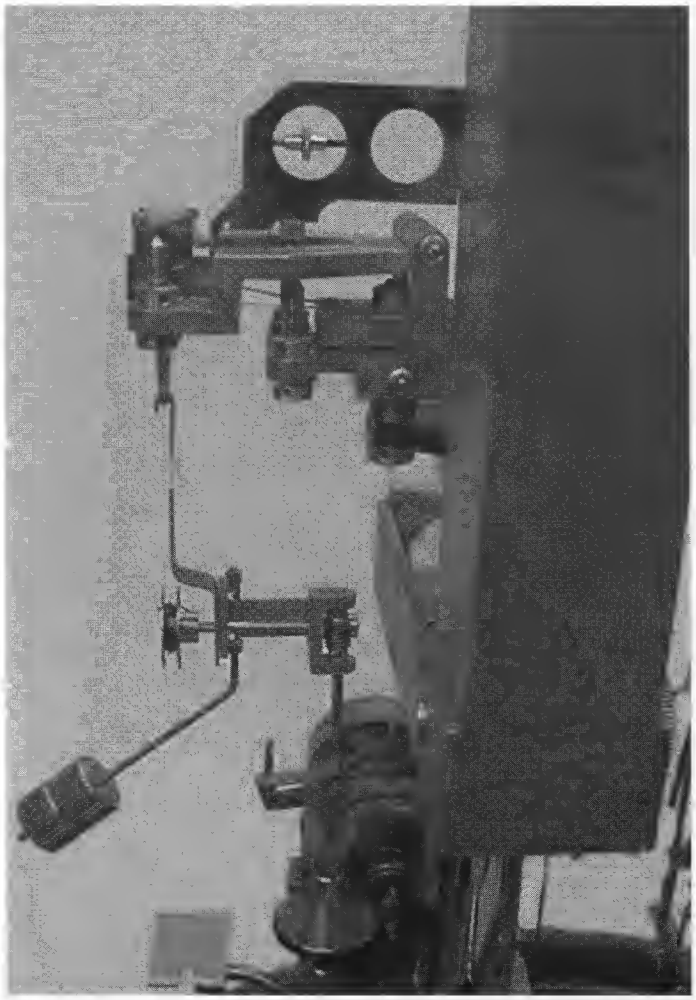


Fig. 5. ➢➢ A close-up of the top indication disc, reading 50mg. (Sartorius moved on to concealed discs shortly afterwards, and had a single viewing hole through which to read the relevant number.) Every item visible is coated in gold, including every screw!
Photo courtesy Christie's South Kensington

The dome gave us the most basic clue that the balance was intended for weighing in a vacuum. By studying the underside of the base, it was obvious that openings through the base could either be sealed for weighing in vacuum, or be left open while the balance was used for weighing in air. But, as the dome was exceedingly heavy and awkward to manoeuvre, nobody would use this balance for ordinary weighing in air.



Studying the pieces that came with the balance, a little gadget drew our attention. It had a hook by which it could be suspended, but not from the tiny beam end that the load-pan was hanging from. We found a simple beam-end with a big enough gap to take the hook of the gadget. By removing the load-pan and its elaborate beam end, replacing it with the simple beam-end, and hanging the gadget, we had a little reel of wire and an arm that caught

Fig. 6. ≺≺ At the top, can be seen half the beam with its zero-adjustment showing in the circular cut-out. The beam end below and to its left is the simple end specially hung on instead of the normal elaborate beam end showing in fig. 3.

From this beam end is suspended the apparatus for raising or lowering samples. The angled "weight" keeps the revolving arm in contact with the electric motor. Without this balancing "weight" the apparatus would tip sideways. The tiny reel of wire shows clearly directly under the beam end and 30mm below it. The wire, when unwound, passed through the slot in the mirror below, and on down through the hole (normally hidden under the load-pan) in the base. Under the base, a sample was attached, for thermo-gravimetric analysis [TGA], (see Fig. 7), or possibly for measuring surface tension.

The large "periscope" box on the right is mostly hollow, but at its bottom is the mirror that takes the shaft of light from the pointer to the viewing lens on the opposite side of the pillar.

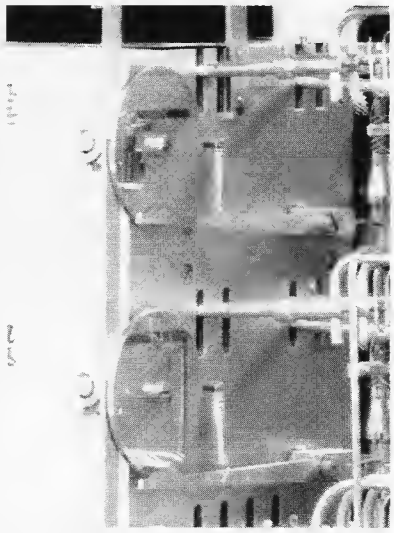
T Allgeier photo courtesy Christie's South Kensington

Thermo-gravimetric Analysis (TGA)

Place the sample (hydrates, plastic, etc) on the end of the wire and tare the balance. Raise the furnace to operating position. Draw the sample up through the furnace, at a specified temperature, causing the sample to lose weight as chemical reactions take place. Take readings as the weights are lifted to keep the balance true. If necessary, repeat with the furnace set at a different specified temperature.

Fig. 7. ⮜⮜ Instructions for the earliest method of thermo-gravimetric analysis.

Fig. 8. ➢➢ Seen from the rear, discs that revolve when the vertical rod behind them moves gradually up. The rod rises when the rear black handle under the base is operated. As the disc revolves, a pin on the circumference descends until it strikes the cam (just about to happen to the lower cam). The cam is part of the long arm going to the front of the box (that conceals all the gearing that moves the weight arms up and down) to connect with the vertical shaft showing clearly in Fig. 5. The long arms are returned to their resting position by the vertical springs in the centre of the picture. Again, everything visible is gilt, some parts with a mirror-finish and some with a matt-finish.
Photo courtesy Christies South Kensington



the movement of a revolving arm on a little electric motor mounted on the pillar. When the motor turned, the gadget revolved, winding the reel up. We thought it might be for surface-tension measurement, but the 1952 catalogue implies that it is for testing the weight-loss of samples against variation of temperature (TGA), the furnace being placed under the base, a process carried out at normal atmospheric pressure. It did not matter that the base was open for the procedure.

Once the load-pan was removed, normal hydrostatic weighing could be done below the base. So the balance could be used for three purposes, (1) weighing in a vacuum (2) measuring chemical reaction-speed and (3) hydrostatic weighing, in a corrosive atmosphere. How did we know it could be corrosive at times? The whole balance is immaculately plated in a thick layer of gold, necessary to protect the elaborate mechanism.

Any balance shimmering with gold looks wonderful, as every shape shows up separately and distinctly. But when the balance has so many moving parts, rows of arms to deposit weights, magnetic damping, rows of discs, cams and spindles, the gold makes it look superlative. There, that special word has been used! The dictionary says that superlative "denotes an extreme or unsurpassed leve". As we stood round the balance we used that word very frequently! One thinks of English as an expressive language, but there are insufficient words for the best!

We did all the ordinary research, measuring each part, checking the function of each bit, ascertaining the materials used for special bits, comparing it with other laboratory balances, recording our findings and thoughts. Those thoughts were whirling about; we needed a specialist in Sartorius; we yearned to have Hans Jenemann at our shoulders. It was only when we dispersed that we calmed down, contacted Sartorius' Museum, searched our catalogues, re-read Hans' books, e-mailed Ritzo Holtman and looked at every Sartorius we could locate.

Gradually information was gathered. This weight-depositing balance came towards the end of the developments of mechanical two-pan balances, there being little left to improve.[1] Sartorius made this model after the Second World War, when materials were available without restraint.[2] They offered it with a gold-plated finish, but did not mention that fact in their catalogue.[3] The serial

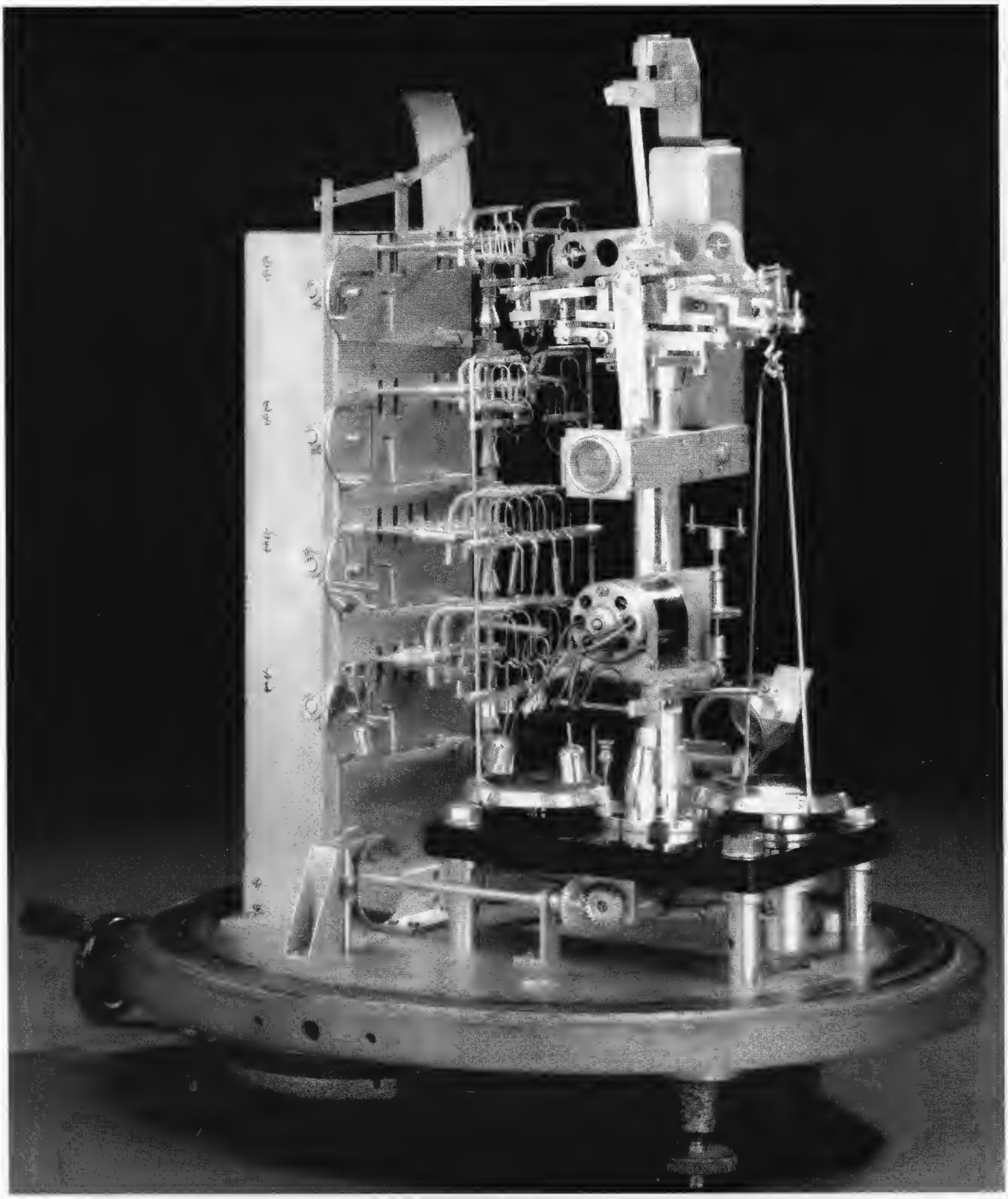


Fig. 9. ⅄⅄ The rear view showing how extras were attached to the pillar. One of the clutches under the base is just visible, and above it are the three holes in the side of the base, that held an attachment for the lamp housing. The lamp shone through the dome onto the pointer, sending a shaft of light along the open box (above the little motor) to the front, where a mirror turned the light down to the graticule so that it could be scrutinised through the lens on the front. Photo courtesy Christies South.Kensington

number locates its production between 1952 and 1956.[4] The only other example located does not have the gold-plated finish.[5] The catalogue offering this design identifies it as a Vacua.[6] Within a year or two Sartorius put a barrier between the load-pan and the weight-depositing mechanism. The newly-developed substitution balances had a severe effect on the marketting of classic laboratory balances and the Vacua was discontinued.[7]

Fig. 10. AA The connection between the clutch under the base and the arrestment gear on the right. If this unimportant part is so beautiful, what is the mechanism like, inside the large box seen clearly in Fig. 8, that controls the movement of the 21 arms that drop the weights onto the weight-bars in such a complicated sequence? Photo courtesy Christie's

We discussed the absence of any offer of gold-plating in the catalogue. If this were an American catalogue, it would have been included, we believe because they had to buy from long-distance, using the catalogue to decide what was appropriate. In Europe a representative of the balance company took his catalogue to the potential buyer, discussed the buyer's needs, and suggested suitable designs. Matters like corrosive atmospheres would have been discussed, and gold-plating offered. The representative then carried away his catalogue, and informed the balance company which balance to send. Thus, there was no need for such matters to be included in the catalogue.

Notes & References

1. Buchanan, P D, personal communication.
2. Allgeier, T, personal communication.
3. Curator of Sartorius Museum, Dipl. Ing. J Barankewitz, personal communication.
4. Oliver, B J, personal communication, discussing the serial numbers on balances in the Science Museum, London.
5. Curator of Sartorius Museum, Dipl. Ing. J Barankewitz, personal communication.
6. Sartorius catalogue c.1952, owned by Ritzo Holtman.
7. Jenemann, H R, Die *Waage des Chemikers, The Chemist's Balance*, Dechema, 1997, p 69. Meier and Mettler were putting Sartorius under considerable pressure.

Biographies

Dr. Thomas Allgeier is an engineer specialising in metrology, liasing with the National Physical Laboratory, Teddington and the PTB at Braunschweig, Germany. His recent enthusiasm for old, mechanical balances has brought him into the group where his erudition is greatly appreciated. His ability to think from first principles when confronted by peculiar balances has added to the solutions found.

Dr. Peta Buchanan wrote her thesis on Precision balances before ISASC started, and has continued to accumulate information on balances ever since. Her skill in research has made her an invaluable ally in the study of Ludwig Oertling and other prominent 19th-century balance-makers. Her ability to get to the nub of every puzzle has resulted in her friends coming to conclusions that they thought beyond them.

Diana Crawforth-Hitchins has studied scales and scale-makers since 1972, gathering information on about 6000 British makers. She considers that knowledge must be shared with scholars and collectors.

Barry Oliver ran a highly-specialised micro-analytical company, working daily with precision balances. His passion for history led him to research (in collaboration with Peta Buchanan) surviving Oertling balances, amazing numbers of which have been studied, recorded, and renovated. This led to his cleaning and putting into operational condition, some of the historic balances held by the Science Museum, London.

Ritzo Holtman, editor of the Netherlands' weights & measures journal, was unable to join us, but provided Sartorius catalogues, helped with translation and led us to the most useful parts of Hans Jenemann's numerous books.

Response from A Pommier

Taking comments in your review, EQM 2516-2517, I would appreciate your giving me a space in which to reply.

Page 2516, referring to Pommier 244 and 247.
One finds the designation *Franse cron* in several Dutch boxes. The name *Franz Cron* or *Franz Krone* or *Franse Crown* is a name given in Germany and the Netherlands, to the currency *Ecu à la couronne, neuf.* The word *Ecu* may be translated as *Shield.* It has been translated as a Crown by the English, archaically, to designate the French Ecu.

Page 2517, *British Coin Weights* by P & B Withers.
This book was impossible to obtain through bookshops in Paris or London, in spite of my efforts, and I only managed to obtain a copy through the good offices of a friend after I had written *Poids Monétaires, I.* This book is excellent, and I fully comprehend that their weight-numbering constitutes an internationally recognised system for British currencies.
Editor. I must plead guilty here. When referring to the Withers book on EQM 1770 and also on page 1793, I failed to include the address from where the book can be bought. Please note that *British Coin Weights* can be obtained from Galata, The Old White Lion, Market Street, Llanfyllin, Powys, SY22 5BX, UK for £95.

Page 2518, Raybay article.
It is true that most coin-weights were intended to be placed in boxes with scales. It is also probable that most of the weights described in *Poids Monétaires*, I, were originally in boxes for more or less time. However, many makers also sold weights separately.
The weights in the collection of the *Monnaie de Paris* are not now in boxes. They are isolated weights, found in the second-hand trade, by private collectors who eventually sold or donated them to the Mint.

Page 2518, weight-holes.
All boxes in our collection made in Lyon contain weights for the currencies of Spain, Italy, etc. and particularly for the currency of France. The Nicholas Raybay box has the general characteristics of boxes made for the trade with Mediterranean countries. So the two weight-holes should theoretically be for the *Louis d'or* and its half. Could the writing say *Ls dor*?
Editor. A second examination of the box still leaves the question open. The writing might say *Ecu dor*, and there appears to be the fraction ½ to the left of the right-hand hole, for the ½ Ecu.

Page 2518, Pistol / Louis.
The example Pommier 364 (Fig. 1) shows the cross with pellets in the corner. This weight could indeed verify either the *Louis* of France or the *pistol* of Spain. That is confirmed by the presence of the Spanish "potenced cross" on the reverse of the weight. Similarly, Pommier weights 380 (for the double Louis) and 387 (for the half-Louis), and the pistol weights in the box by Nicholas Raybay were for both coins. To jump ahead (see EQM 2553-2555), Part II of my catalogue shows weights properly for the currency of Spain, but by adding little lys, signal that they were equally valid for the Louis of France. See Pommier 924 to 927.

Fig. 1. ⅄⅄ Pommier 364, showing the young head Louis XIV of France wearing a laurel wreath . Stamped with a crowned N beneath his chin. The reverse has the Spanish potenced cross with a French fleur-de-lys on each diagonal pointing inwards, thus indicating bivalence.

More Solder Weighing

BY A RANGELEY

In Oct. 1985 Christie's South Kensington, London, sold a solder-computing scale made by W Butterworth, Maker, Tutbury, Staffordshire. The steelyard indicated the percentage of tin in solder and the scale was complete with nine conical-shaped samples of known tin-content, the whole contained in a glazed wall-cabinet. The design is similar to the US designs shown by Berning, EQM 2525-9.

Fig. 1. ⩚⩚ W Butterworth solder scale. Photo courtesy A Rangeley

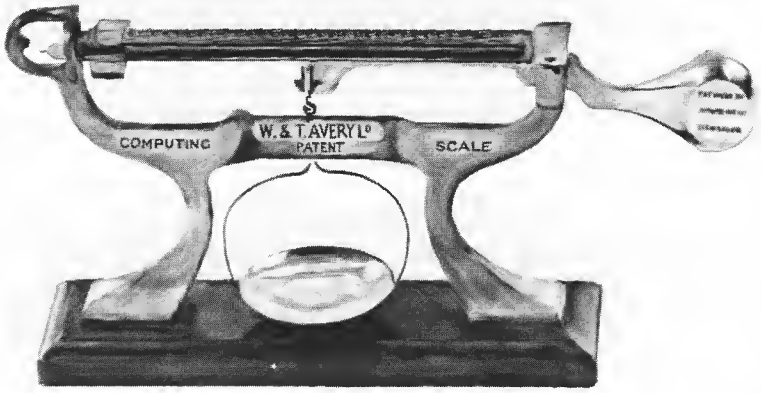


Fig. 2. ⩚⩚ W & T Avery Ltd solder scale, c.1910. The scale was based on the Type 345A model and was offered c.1910, the price in 1916 being £16..10 shillings, which equated with US. $66 at that time.

The weighing-machine company[1] that devoted more space to the manufacture of weighing equipment than any other company in the world, also made a solder computer which indicated the percentage of tin and lead in a sample. Such a scale is now part of my collection, and I have no knowledge of another in the United Kingdom. As with the Butterworth model, there are nine conical samples of solder, of which three had one density, two had another density, two had another density, and two each had yet another density. The brass steelyard is graduated 0 to 100% for lead on the upper part, and 100 to 0% for tin on the lower, the poise being shaped as in Fig. 3. The steelyard was back-weighted (pre-loaded) and the divisions diminished between 0 and 100%.

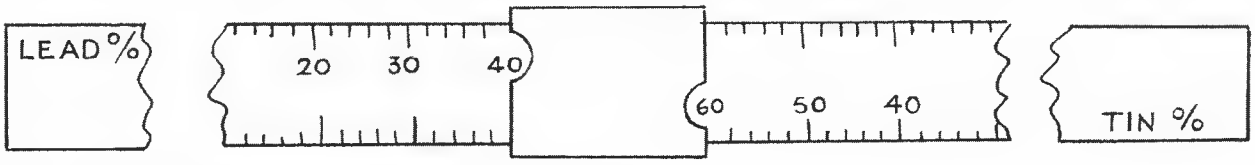


Fig. 3. ⩚⩚ Beam of the solder scale made by W & T Avery Ltd.

1. The company is of course, W & T Avery Ltd, founded in 1730 and discarded like an empty cigarette packet by GEC. The company is now under the aegis of an American company that, hopefully, will continue to maintain the name *Avery* that is synonymous with a tradition of excellence.

Editor - Albert Rangeley was selling the products of W & T Avery Ltd for much of his working life, and has a fund of fascinating stories about selling techniques and about his customers.

Notes & Queries

N & Q 143 Response on Chromium-plated Weights — From A RANGELEY

J W Towers & Co. Ltd of Widnes, Lancashire, offered chromium-plated weights in 1959 for analytical use. Philip Harris Ltd, of Birmingham, offered them in 1952, MacAlaster Bicknel Co. (Labasco Inc.) of Cambridge, Mass, offered them in 1960, Baird & Tatlock Ltd., in 1966 and Eureka Scientific Co. Ltd. of Ilford, offered them in 1958.

Between 1904 and 1950 none of the following companies offered chromium-plated weights:- Griffin & Tatlock, Gallenkamp, Townson & Mercer Ltd, W & J George Ltd, F E Becker, Philip Harris Ltd, Baird & Tatlock. It is therefore reasonable to assume that they were offered generally in the 1950s onwards.

The above weights were not subject to the jurisdiction of the UK Weights and Measures Authorities, as indeed were not the bankers' weights which proliferated during the second half of the 20th century, but as far as trade weights were concerned, chromium-plated weights were specifically precluded by Regulation 51 of the 1907 Weights & Measures Regulations.

Editor - Baird & Tatlock (London) Ltd. sent non-magnetic nickel-chromium alloy gramme weights and sub-divisions, ('superior to chrome-plated weights') to the National Physical Laboratory for particularly precise testing in 1944. See Baird & Tatlock's 1947 catalogue for the Certificate issued.

N & Q 144 More Solder Scales — From A J CRAWFORTH

Herman Kohlbusch Sr. Inc offered, at $50.00, the Fairbanks solder scale as shown in Fig. 1 on EQM page 2525. The catalogue is not dated, but it is catalogue 25, and it says "Incorporated 1908". It is apparent that Fairbanks lent the printer's block to Kohlbusch to use in their catalogue.

Golden Scales, c.1090 B.C.

BY G NEWALL

After reading the article by Lionel Holland, *Weights of the Bible*, I thought of this, from *The Bible as History* by Verner Keller. It refers roughly to the time when David was King of Israel.

"After the death of Ramesses XI, the last of the Ramessid dynasty, in 1085 B.C. Egypt fell into the greedy lands of a priestly clique who ruled the land from Thebes. Vast wealth had come into the possession of the temple. Their herds of cattle amounted to half a million head. The priests had at their disposal a fleet of 88 vessels, 53 workshops and wharves, and 169 villages and towns. The pomp with which the daily ritual of the great deities was carried out beggared all description. To make the temple scales alone, on which the sacrifices at Heliopolis were weighed, 212lb of gold and 461lb of silver were used."

No doubt there are those who would question the means by which the figures were obtained. The same people might well ask about the purity of the metals but there is no escaping the fact that this must have been a spectacular scale.

A final thought is to wonder what happened to it. Was it destroyed, melted down and re-cycled? Or is there just the slightest chance that it was buried somewhere and remains there awaiting discovery?

John P Gruber & Competitors

BY E MAHONEY

Two items were issued by John P Gruber of New York City. The piece pictured in figure 1 is marked APOTH. WEIGHT ONE DRAM 1863, and weighs 58.12 Troy grains (3.766 grams). The reverse is stamped JOHN P. GRUBER NEW YORK, and has the same die break as the piece illustrated in Vangroenweghe and Geldof.[1] Whether other examples of Gruber's apothecary weights exist has not been learned.

Fig. 1. ⮝⮝ Gruber apothecary weight for one dram, weight 58.12 grains (3.766 grams). The spelling *dram* was used interchangeably with *drachm* until about 1890.

The second item is an Indian cent on the obverse with a scale and 178 Chatham Square, Gruber's address, on the reverse.

Various editions of the *New York Commercial Register*[2] carried the John P Gruber advertisements.

JOHN P. GRUBER,
Nos. 168, 170 and 184 Chatham Square, New York,
MANUFACTUERER OF SCALES.
J. P. G. has constantly on hand a very superior assortment of Assaying, Bank, Brokers', Jewellers' and Gold Scales; Grocers', Druggists, and Prescription Scales, with Marble, Brass, and Iron Columns; Counter and Excelsior Scales. Gold and Druggists' Weights adjusted to any standard. Brass and Zinc Weights.

Fig. 2. ⮝⮝ Advert of 1861/2 for Gruber, specifically referring to Druggists' Weights adjusted to any standard. The spelling of 'manufacturer' is correct in the 1860 advert but incorrect in 1861/62! Zinc weights were previously only recorded as being made in war-time Germany.

Only in 1860 and 1861/2 did Gruber have an advertisement in the *Commercial Register*, and the second advert differed from the preceding one in format but not content.

From 1861 through 1866/67 John P Gruber was listed in the *New York Commercial Register* at various premises on Chatham Street with his house at 2 Mott Street. In 1862 he is listed as John P Gruber, 2 Mott, h. 178 Chatham.

A rare daguerreotype of Chatham Square was on display through January 7 2001, at the New York City Metropolitan Museum of Art. It has been reproduced in *Art and the Empire City,*[5] the title of the exhibition as well as the book. The book has the following description of Chatham Square which provides some piquancy as the location of a New York scale-maker.

"Chatham Street and Chatham Square, which connected the southern end of the Bowery to the Park, were the home not only of sidewalk booksellers,

Fig. 3. ➢➢ From a compilation of 19th century American scalemakers in preparation by ISASC member Steven Beare. Courtesy S Beare

John P Gruber

1855-1857 at 51 Beekman
1858-1860 at 168, 170 & 184 Chatham
1861-1865 at 184 Chatham & 2 Mott
1866-1870 at 186 Chatham & 3 & 41 Mott
1871 at 184 Chatham & 3 & 41 Mott
Awarded Diploma for a well-finished large bank scale at 1859 American Instrument Fair. Also awarded first medal and a diploma for a bank scale at 1867 American Instrument Fair. For the 1870 Products of Industry Exhibition, Gruber made $7100-worth of pumps and scales. He employed 2 men and 2 children.

pawnbrokers, old-clothes sellers, and "mock auction" houses (where the bidding was rigged against the unsuspecting) but also of silversmiths, jewelers, furniture dealers, and shoe stores. Chatham Square was a Jewish residential center (the city's oldest Jewish cemetery is there), and so many Chatham Street merchants were Jewish that it was sometimes referred to as Jerusalem. It was also the site of the Italian Opera House, which failed and was converted to the National Theatre, a favorite working-class venue".

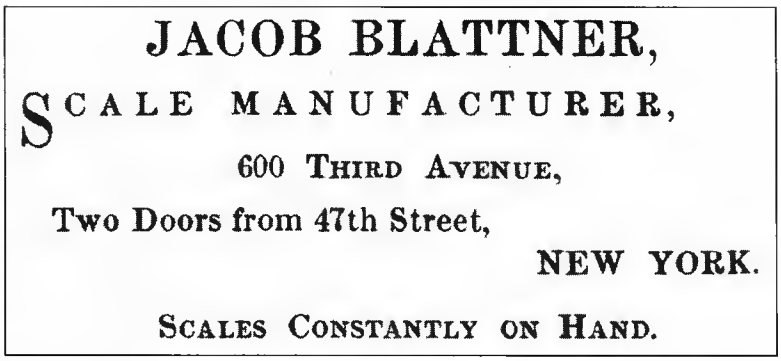


Fig. 4. AA Advert of 1861/62 for Jacob Blattner, a singularly uninformative advert for a particularly interesting man! See EQM page 1976 for wonderful details of his advert when he worked in St. Louis in 1866.[3] The two adverts prove the way that readers can extend their knowledge of the migrations of a maker by using different sources.

The Chatham Square area still exists in New York City on the southern edge of contemporary Chinatown with as much color and vibrancy as depicted in the above description. Chatham Street is now Park Row leading from the New York City Hall area and a current map has a building marked *2 Mott* near the intersection of Park Row and Mott Street.[6]

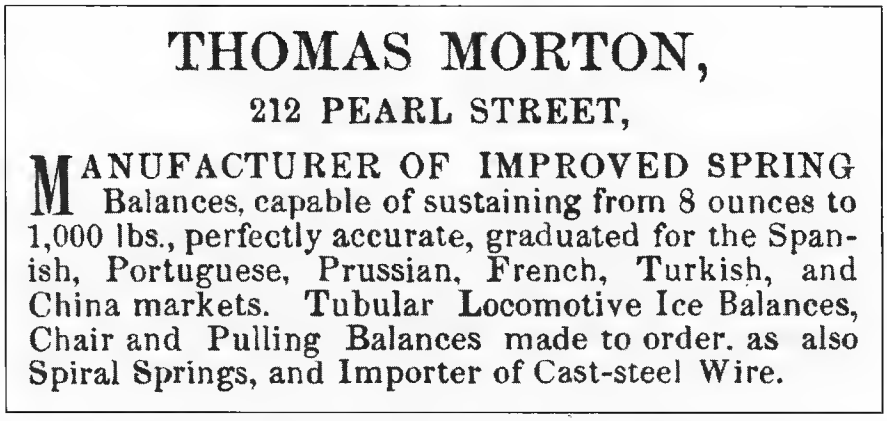


Fig. 5. AA Advert of 1864 for Thomas Morton, who obviously prided himself on his extensive exporting.[4] 'Pulling balances' might be tension-testers for ascertaining the pull of an engine. Morton (previously Morton and Bremner) specialised in spring balances ranging from ones that measured as little as a quarter of a dram, up to those measuring 2,000lb.[4]

Another 1859 source[7] has a

Fig. 6. AA Advert of 1864 for the New York Journeymen Scale Makers. The same advert still being used in 1865/66.

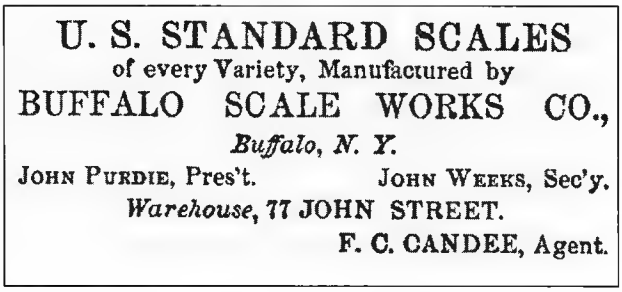


Fig. 7. AA Advert of 1864 for Buffalo Scale Works Co. It is interesting that the company had a warehouse right in the city, but scarcely surprising, Buffalo being nearly 500 miles from New York.

listing for Herman Kohlbusch Jr, Chemical Apparatus, 41 Union Square, ranked with manufacturers of note, whereas Gruber was not included in that category.

The advertisements of other scale-makers were in the same directories and may be of interest to collectors researching their own scales.


JOHN CHATILLON,
MANUFACTURER OF PATENT BALANCES,
Spring Balances, Platform and Counter Scales,
93 *Cliff Street*, New York,
Keeps constantly on hand a large assortment of all sizes of Patent Balances, from 50 to 5000 pounds, complete with frames and hooks, etc., and standards graduated to foreign countries. Also, Portable and other Platform Balances, Counter Scales, Spring Balances of all the different sizes.

Fig. 8. Advert of 1865/66 for John Chatillon, a particularly large company in direct competition with Thomas Morton.

Notes and References

1. Vangroenweghe & Geldof, *Pondera Medicinalia*, Brugge, 1989.
2. *Wilson's New York Commercial Register*, New York, 1859 etc.
3. Wright, B, 'How I Started,' *Equilibrium*, 1996, pp 1975-1976. Betty reports that Blattner is listed in *Edward's St Louis Directory* as "Mathematical, Philosophical and Optical Instrument Maker, Pine Street, bet. 3rd and 4th."
4. Asher & Adams *Pictorial Album of American Industry 1876*. This compilation claims that Morton, with A A Bremner, introduced the American public to the domestic spring balance in 1842.
5. Voorsanger, C H, editor, *Art and the Empire City*, New York, 1825-1861, Metropolitan Museum of Art, Yale U P, New Haven & London, 2000.
6. *New York City Map*, issued by Marriott Financial Center, 1999.
7. *New York, The World's Metropolis, 1623-4-1923-4*, W Thompson Bonner Commemorative Edition, Polk & Co, 1924.

Review

Poids Monétaires II, Poids pour monnaies non françaises, by Aimé Pommier, Secrétaire général de la Société métrique de France, published by the Monnaie de Paris, 2001, ISBN 2-11-091773-3. 8¼ x 11¾inches, A4, 140 pages, 647 weights photographed (both sides if necessary), plus 12 black & white photos of boxes complete with many weights. In straight-forward French. Price 185 F, or £28.20. Available from the Musée de la Monnaie, 11, quai de Conti, 75006, Paris.

This second part of the catalogue of the weights in the Museum of the Mint in Paris deals with the weights for European non-French coins only, with consecutive numbers from 601-1247. Part I dealt with weights for French coins only, and deals with Pommier weights 1-600 (reviewed EQM 2516-17). Pommier has arranged the weights by the country of origin of the COIN for which the weight was made. Hence, any weight made to weigh the moidore, be it Antwerp or Dublin, is placed under the one heading. No weights for German coins are included, nor are there any weights made in Germany for coins of other countries, but this omission is not explained.

[Editor: Pommier tells me privately that the Mint has only 24 German weights, and that a decision was made to omit so small a sample.]

As in Part I, the section starts with the coin, giving its period of manufacture, the monarch under whom it was made, its description (but no picture), its mass and its common names. There is no attempt to define the period during which the weight was made, and only sometimes to say where

the weights were needed, as with weight 811 (Angleterre, France, Irlande). Obviously, it is difficult to give exact explanations, but Pommier must have a better idea than most of their use, and could have helped his less-expert readers.

Dealing with such a diverse range of coin-weights is horrendously difficult, and every arrangement has its advantages and disadvantages. The provenance of each weight is often unknown, so Pommier had to work from internal evidence.

For example, he must know, when looking at weight 603 that AD W is the mark of Arnoldus (Aertus) van Dunwalt, working in de Croene, op den hoek van de Oude Borse, Antwerp, who was born in 1620 and having dates on weights ranging between 1642 and 1650.[1] So, Pommier knows that the weight in the Paris Mint is a very late example, being dated 1665. But Pommier restricts himself to a straight description, without explaining what the initials stand for, or stating that the weight is unusually late for this maker.

A second example is the weight 818, which has S 18 4.15 surrounded by tulip flower-heads going clockwise round the border. Pommier comments that 4.15 is over the standard weight for the *pièce de deux écus* (quarter Joannes or Portuguese piece), that most weight-makers put at 4.14½. He does not explain that S 18 means 18 shillings, and so is a British weight. He does not point out that the weight is part of a long set, Withers 1751, made between 1774 and 1800 in England by Berry of Birmingham, brass founders.[2]

Occasionally, Pommier does include comments, such as the most helpful remark about bivalent weights used to weigh two coins. See the remarks with Pommier 899, 925, 987 and 1146, and EQM p 2548. He comments on abnormally high mass, (Pommier 913), erroneous mass, (Pommier 1215), coats of arms, (Pommier 1137), tale, [the number of coins to be made from a certain quantity of metal] (Pommier 1031), and mistakes in manufacture (Pommier 985). It is necessary to remember these comments, as they are not repeated or referred to, even when it would help to be reminded.

The weights 690, 691, 692, 693, bear the seller's names Richard Litchfeild (sic), Sam[l] Kerison (sic) A G (Anthony Giles) and W H (William Hayward) respectively, that came from three workshops, two of which lasted for over thirty years. A full discussion of these weights, made during the reign of William III, is in Withers p. 92-93 and 110-112.

Pommier has not noted the minute B on some weights. Could 637, 682 and 684 be from dies made by Briot when he came to work at the London Mint? This Frenchman had a huge effect on English weight-design during the reign of Charles I. The superb, very rare weight 1064 , Fig. 1, looks like a Briot design made before he came to work in London in 1632.

Fig. 1. ⅄⅄ Weight for the silver *Daldre de Bourgogne*. On the reverse is a handsome crown and XXII DE with a tiny fleur-de-lys below.

The most helpful feature to the reader is the photograph of each weight. The photographs are clear, and show that the original collectors of the weights had a strong preference for good clean weights without too much wear. Many of the weights are in excellent condition, and some are extremely rare. Weights 784 and 785 are not in Withers, a sure sign that they are rare, the Withers having studied and recorded so many British weights.

Another rarity is weight 801, a £3.12 weight from a long set, clearly showing BENTON LIVERPOOL, a beautiful weight not shown in Withers. See Fig. 2. No other reference to Benton is known in weights literature, except in Lavagne[3] where Benton is said to be 10th century! An Edward Benton, toyman, worked at 171 Dale Street, Liverpool in 1774. [Toymen sold small trifles for adults, such as spectacles, compasses, pencils, scent bottles, candlesticks, and some toymen sold scales.]

Fig. 2. ⅄⅄ English weight for the largest Portuguese gold coin circulating in Britain between about 1732 and 1780. Made by or for Benton of Liverpool.

Other rarities are 703 and 704, bearing very handsome portraits of George III on the obverse and Dw Gr 5 6 and 5 8 respectively. See Fig. 3. The G is curiously shaped and similar to Withers 1900, so conceivably they are guinea weights from the same set. But the quality of the portrait on the ones in the Paris Mint is greatly superior to the ones shown by Withers.

Fig. 3. ⅄⅄ Pommier 703 and 704. English weights made about 1775, during the reign of George III, and verified in London. The 5.6 was for guineas minted before 1772 and the 5.8 was for guineas minted since 1772.

Pommier 701 note; Kirk worked from 1740-1772. Weight 726 (Withers 1986A) bears the date 1775 not 1772. Weight 700 (Withers 1063) was made after the coin was issued in 1633 with a modified design (the King's scarf flys out behind his waist).

The reviewer has concentrated on the weights for British coins and the weights made in England for Portuguese coins, as those are familiar. The reliability of the captions, and the useful comments in the headings, give every confidence in Pommier's catalogue, so the book can be recommended for use in identifying European weights, for studying the details of the designs, and to get a vague idea of the weights needed in Europe. (This last comment must be seen in the light of the buying preferences of the original collectors, and the place where they bought.)

Pommier's knowledge is highly respected, and this book will assist the less-experienced coin weight collector, and people interested in getting an over-view of European weights. It is an enjoyable book, particularly for its photographs, and it is a very reasonable price. D F C-H

Notes & References

1. Wittop Koning, D A, & Houben, G M M, *2000 Jaar Gewichten in de Nederlanden*, 1980.
2. Withers, P & B, *British Coin Weights*, Llanfyllin, 1993.
3. Lavagne, F G, *Balanciers Etalonneurs*, Montpellier, 1981.

Editor - if you have bought the *Poids Monétaires*, you can get a free copy of the Supplement containing notes and additions, particularly those concerning the marks of the makers and the verification marks. Also inaccuracies are rectified. Please return the form slipped into Part II, or write to the Musée de la Monnaie, 11 quai de Conti, 75006, Paris.

Birds of a Feather

BY J R KATZ

On the subject of small bow-front spring balances perhaps it is not correct to refer to Gorham scales, Tiffany Studios scales, Heintz Art Shop scales, Jennings Bros scales and Apollo Studios scales. After all, these companies did not make scales, they were metal workers of some sort - Gorham were silversmiths, and the other four were makers of decorative metalware during America's Arts and Crafts and Art Nouveau movements, at their apogee in the years 1900-1920.

The common weighing mechanism used by each of these firms was the Gilfillan patent of June 2, 1896 (EQM 622) for a bow-front spring balance made by the Pelouze Scale Co. of Chicago, so they were all *Birds of a Feather*. The Pelouze bow-fronts, and bow-fronts by the users of their mechanisms, all have the same patent numbers printed at the bottom of the chart, whoever made the shell. The various patent dates given are: June 2, 1896; March 29, 1898, and Jan 31, 1899. Interestingly enough, the chart on the Heintz has additional ones of March 10, 1903 and May 26, 1903, dates which also appear on the base of the Pelouze Star. And early Jennings Brothers scales have "Patent Pending" in addition to the first three dates, suggesting that they were made between 1899 and 1903.

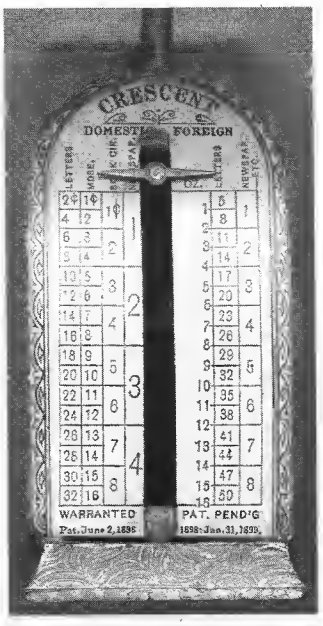


Fig. 1. ➢➢ The first three dates, June 2, 1896; March 29, 1898, and Jan 31, 1899, appear on the very bottom line of the chart used by the Jennings Brothers.
Photo courtesy D Hitchins

Fig. 2. ➢➢ The base of the Pelouze STAR, a list that omits Jan. 31 1899. However that date is shown at the bottom of the chart of the same instrument.
Photo courtesy D Hitchins

Gorham

It is clear that Pelouze contracted to provide their scale mechanisms for certain models of the Gorham sterling silver pieces, and, further, I believe that, of all of these firms, Gorham was their first user of that particular mechanism - they were a bit earlier than the others. Tiffany Studios, Heintz Art Metal Workshop, Jennings Bros and Apollo Studios, all aware that Pelouze did good work, followed

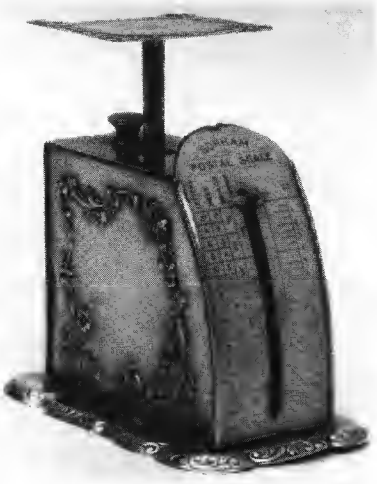


Fig. 3. ➢➢ The only scale that has, replacing the trade name of Pelouze, CRESCENT, the name of the maker of the shell, GORHAM. The same design, also in silver, is shown in the Pelouze catalogue of 1911, called there the PRINCESS, and costing nearly double the cost of the brass version. Size 1¾ x 3 x 3¼ inches. Photo courtesy J Katz

Gorham in buying their scale mechanisms from Pelouze. Figure 3 shows the Gorham silver scale. Note the chart marked GORHAM.

Tiffany Studios

Tiffany Studios was the company founded by Louis C Tiffany in 1900, to make decorative items using various metals and metal treatments in combination with Favrile glass (an iridescent glass with a silky surface). One of their popular lines was a desk set including a blotter, inkwell, letter opener, letter-rack, etc. An additional accessory offered was a postal scale, the bow-front spring balance. These desk sets were offered in over a dozen patterns and some with different metallic finishes. Seldom does one see these desk sets complete; sometimes only parts of desk sets, but most rarely seen is their scales. I believe the scales were the least-made accessories of their desk ensembles, and that is why they are not seen today. Figure 4 shows the Tiffany Studios scale in the Grape Vine pattern. Note the dial is marked CRESCENT. My purpose here is not to provide a complete treatment of Tiffany Studios as a fair amount has already been written about their postal scales.

Fig. 4. ⅄⅄ The Grape Vine design of Tiffany Studios' bow-front. The Favrile glass is green-marbled, reminiscent of malachite. This example is the smaller, less rare size, 1¾ x 3 x 3¼ inches. Photo courtesy J Katz.

Fig. 5. ⅄⅄ Heintz Art Metal Shop bow-front. A lively Art Nouveau design in silver on the bronze side-panels. Size 1¾ x 3 x 3¼ inches. Photo courtesy J Katz

Having said that, I'd like to break ground on the other *Birds of a Feather*, Heintz Art Metal Shop, Jennings Bros and Apollo Studios.

Heintz Art Metal Shop

The Heintz Art Metal Shop evolved from an Art Crafts Shop, purchased in 1903 by Otto Heintz, one of the Heintz Brothers, a manufacturing jewelry firm in Buffalo, NY. In 1912, Otto Heintz received a patent for his process of sterling silver overlays on bronze without the use of solder. The rest is history, as they say. Heintz Art Metal made all sorts of decorative items - lamps, vases, frames, bookends, etc, and even a postal scale. Otto Heintz died in 1918 and with the effects of the Depression, this prolific company ceased trading in 1930.

The scale shown in figure 5 is identified only by its marking on the chart, CRESCENT. As with the Tiffany Studios' scales, the mechanism was made by the Pelouze Scale Co. and the postal rates on the chart were current from 1913-1925, fitting nicely into the Arts and Crafts period. The shell [housing] for the mechanism is

patinated, textured bronze with a silver overlay scroll design on each of the sides. The shell is affixed to the base of the scale with bronzed round-headed screws. I believe Pelouze must have sent their scale mechanisms to Heintz for assembly, rather than the other way round, because both the Pelouze scale base, which is not covered by the shell, and the letter plate have been treated to produce the same bronze patina as the shell; I doubt whether Pelouze had the capability to produce this finish. In this regard, Tiffany Studio's scales are more integrated; scale and shell are treated as one and not as separate pieces.

Fig. 6. AA This bow-front has been illustrated previously in EQM 623, in the belief that it was entirely Pelouze. Jerry Katz is the first to publish the information that the shell was made by Jennings Brothers. Size 1¾ x 3 x 3¼ inches. Finish gold-bronze over spelter. Photo courtesy B Stein

Since there were no markings on this scale, other than CRESCENT on the chart, I was presented with a challenge in identifying it. I had a passing acquaintance with Heintz Art Metal workmanship from exposure to the stock of other antique dealers. The finish I was presented with looked like Heintz Art Metal - but I needed to be certain. Collectors' guide books covering Heintz Art Metal do not mention or show evidence of a scale. After some searching, I made contact in David Surgan, an antique dealer exclusively handling Heintz Art Metal, and a contributor to the *Journal of the Arts and Crafts Movement.* He confirmed that the scale shell was indeed the work of Heintz Art Metal and that it was only the second Heintz Art Metal scale known (to his knowledge). Furthermore, as a foremost specialist in Heintz Art Metal he had never owned one or had one for sale. I was amazed by that!!

Fig. 7. AA Side view of the Jennings Bros. scale, showing the crisp relief modelling of the flowers. Photo courtesy D Hitchins

Jennings Brothers

Jennings Brothers had slightly more helpful marks on their bow-fronts. The chart had CRESCENT at the top and the base had JB 668 cast into it- the number 668 was their catalog number as they marked their items "JB and a number." They used a very heavy three-dimensional zinc-alloy casting round the Pelouze mechanism, thickly plated with a bright gold-bronze finish. See Figures 6 and 7. Jennings Brothers made decorative things, and one of their most important lines was their bookends. Brothers Edward and Erwin Jennings started work in 1890 and finished in 1953, located in Bridgeport, Connecticut.

Apollo Studios

On the fourth Bird - Apollo Studios - their assembly is very much like that of Heintz Art Metal, i.e., a designed shell around a Pelouze CRESCENT scale mechanism. But their finish is clearly a poor man's version of the Tiffany - using

treated metal and glass. In this case, the shell is truly that; it fits around the scale mechanism merely by force-fit - not fastened by screws, as in the case of the Heintz Art Metal scale. They also treated the exposed scale-parts to match the patina of their shell. Maybe even including 'Studios' in their name was part of their scheme to conjure up a Tiffany Studios image. See Fig. 8. Note that the chart is marked CRESCENT. Figure 9 shows the APOLLO STUDIOS stamp on the rear panel.

Fig. 8. ⮝⮝ Apollo Studios green-marbled glass, with cut-away design of leaves and twigs, a close imitation of Tiffany Studios' Grape Vine design. The distinctive feature is the row of beads decorating the joins between the panels. Size 1¾ x 3 x 3¼ inches.

Photo J Katz

Who were they? With limited time and travel resources, I was able to find out that Apollo Studios was a trade name only, not an incorporated entity, and it was a trade name for Bernard Rice/Bernard Rice's Sons, of New York City, from about 1910-1934. They were listed variously under Silversmiths, Plated-ware and Art Works. Using the scale as an example, it appears that Bernard Rice and his Apollo Studios were intent on competing directly with Tiffany Studios. Perhaps they could duplicate that look more easily than that of Heintz Art Metal. At a distance of five to ten feet an Apollo Studios scale and a Tiffany scale would look very much the same. Not having seen another Apollo Studios scale it is difficult to assess just how successful a competitor he was. To my knowledge, there is no general reference material or guide book available relating to Apollo Studios as there is for Heintz Art Metal and for Tiffany Studios. An erstwhile vest-pocket dealer in the decorative arts, when asked about Apollo Studios, replied, "Oh, they made things similar to Tiffany", but he knows of no scales, nor could he provide any of their corporate history.

Fig. 9. ⮝⮝ The centre of the rear panel showing the stamp APOLLO STUDIOS NEW YORK.

Photo J Katz

Unlike my experience with Heintz Art Metal, I have no recognised expert to esteem me when he tells me that there are just two scales he knows of, but I have a feeling that there may be even fewer Apollo Studio scales!

Additional research should be undertaken to discover just how close to the truth I have come, and reveal more about these Birds of a Feather.

Showcase

Fig. 1. ➤➤ On the left is the base of a Tiffany stamped TIFFANY STUDIOS and on the right is the base of an Apollo Studios. Note the superior method of making the Tiffany base. The tabs holding the Apollo together can easily snap.

Photo courtesy D Axelrood

Fig. 2. ➢➢ The real Tiffany on the left, an open-sided Pelouze Crescent in the middle and an anonymous bow-front (now known to be an Apollo Studios), on the right.
Photo courtesy D Axelrood

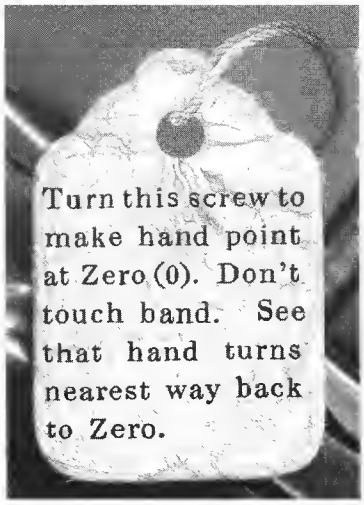


Fig. 3. ⩓⩓ This label is attached to the adjustment screw of a Pelouze Star. The wording makes it clear that Pelouze attached it to their circulat dials as well as to their bow-fronts.

Fig. 4 ⩓⩓ Base of the Pelouze Countess. It is stamped PAT. AUG 3, 97, MCH 29, 98. PELOUZE P CHICAGO. PATS PENDING. QUADRUPLE SILVER PLATE
Photo courtesy D Hitchins

Fig. 5. ➢➢ Tiffany parcel scale, the Columbus, beside the Tiffany postal scale, the Crescent. The Columbus is 6½ inches high and the Crescent is 3½ inches high. The vivid green marbling on the Favrile glass is very apparent in this picture. Photo courtesy R Axelrood

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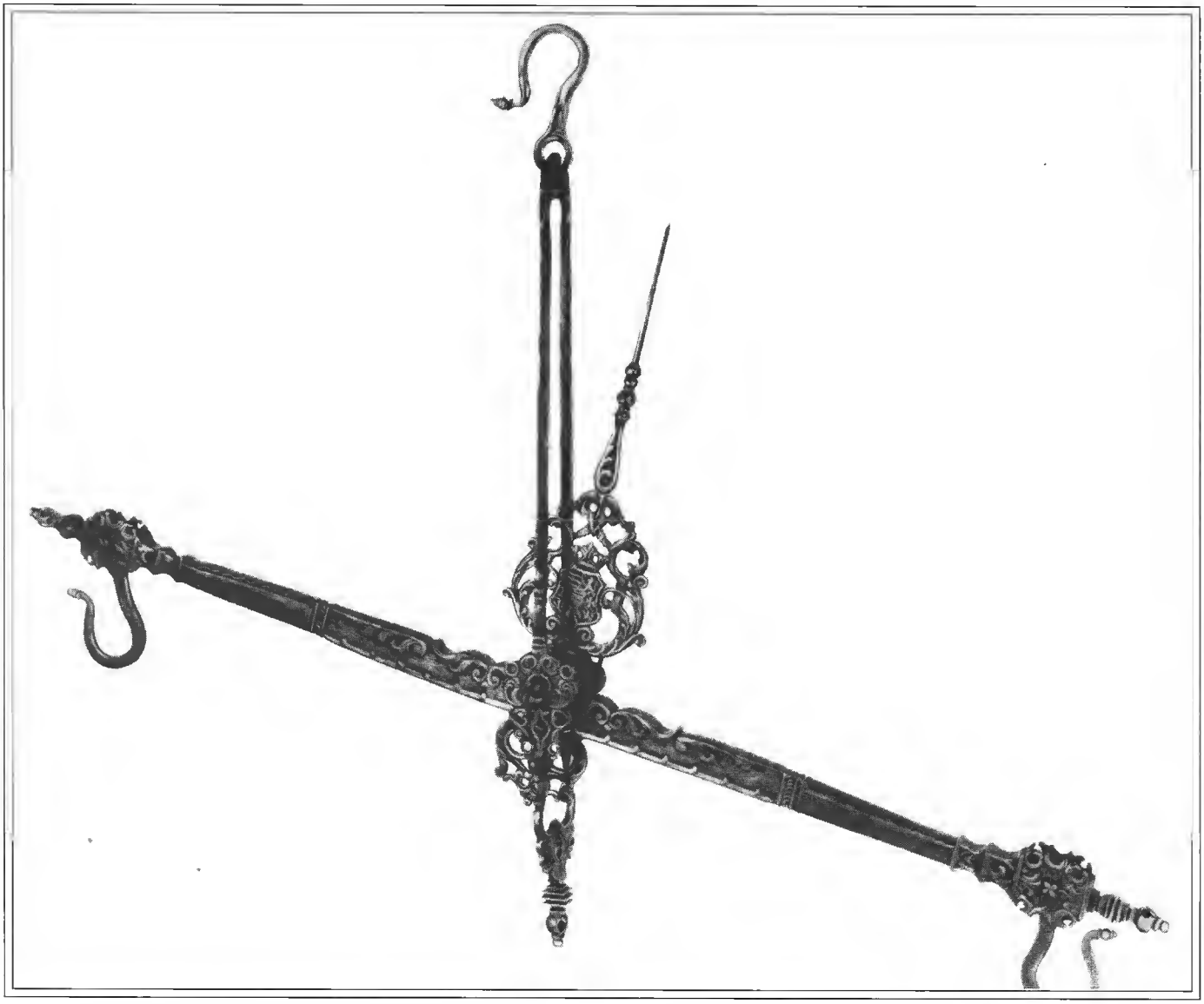

Cover Picture & Review

Units of Measurement, An Encyclopaedic Dictionary by Stephen Dresner, published by Harvey Miller & Medcalf, Aylesbury, 1971. SBN 85602 002 8. 287 pages, 13 appendices, 61 tables.

This dense book is for reference, thoroughly covering units of Imperial measure (US and UK) and an amazing number of modern units for electricity, velocity, weight, wind speed, yarn, earthquakes, musical notes, heat, volume and numerous other obscure things that need measuring. The first half is a straight-forward dictionary, explaining in words and mathematical formulae what a particular unit is (an impulse, a spat, a slug, a brill, a langley) and the second half explains categories of units admirably, with supplementary tables to put all in sequence. Even scientists who have given their names to units are listed with their country and dates; symbols for quantities are alphabetically listed. Not every word is indexed, so some intelligence must be applied, eg. pottle comes under obsolete and old-fashioned units only and not in the index.

The magnificent scale on EQM's cover is on the cover of the book, without a caption. It has a distinctive coat of arms at the base of the pointer. Does any reader know which collection it is in? How big is it? Can any reader identify its country of origin?

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Folders for Foreign Coins

BY S CAMILLERI

English Folding Gold Balances for Weighing Foreign Gold Coins

This kind of balance was manufactured either for the English local market, or for exportation to foreign markets.

English Local Markets

It is known that foreign gold coins were current in England especially during the years preceding the 1774 Great Recoinage.[1] Mostly in circulation were Portuguese gold coins, owing to the heavy trade that England had with Portugal ever since the Methuen Treaty of 1703;[2] think of port wine alone, so popular from the reign of George III onwards.

The Portuguese gold coins then current belonged to two sets:
The Moidore series, the Moidore being worth 27 shillings since 1717, and the Johannis series, the Johannis being worth 36 shillings. Thus the coins were as in Fig. 1.

Moidore	one	half	quarter		
value	27s.	13s..6d	6s..9d		
weight in grains	166	83	41½		
weight in grams	10.75	5.38	2.69		
Johannis	double	one	half	quarter	eighth
value	72s.	36s.	18s.	9s.	4s..6d.
weight in grains	444	222	111	55½	27¾
weight in grams	28.76	14.38	7.19	3.59	1.78

Fig. 1. ⅄⅄ The foreign coins current in England between about 1730 and 1780.

The following examples are in my collection:

Thomas Williams, Scale Maker, No. 71 Cannon Street, London. Fig. 2.
Brass beam graduated 3 to 9 pence Sliding weight with the incuse inscription

	P	G
1 LAMOEDE	9.	6
½ LAMOEDE	4.	15
¼ LAMOEDE	2.	7½

LAMOEDE probably stands for Lisboa Moeda (Lisbon currency). The balance was therefore meant to weigh 3 coins of the Johannis series, the 36s, 18s, and 9s. piece.

Fig. 2. ⅄⅄ Thomas Williams started work in 1776, when the Johannis coins were being called into the Mint to be melted down and reminted as English guineas. Thomas Williams obviously thought that enough Portuguese coins were in circulation for customers still to buy scales to weigh those coins solely.

Because the graduations on the beam are in pence, and the inscriptions on the sliding weight are in pennies and grains, it is most probable that the balance was intended to be used in England and not in Portugal.

N.B. It is relevant to note that the Italian Republic of Genoa, which also had strong commercial links with Portugal, called under one denomination the above two series of Portuguese coins, the *Lisbonina*, which translates as the Piece from Lisbon, but is actually the Moidore, [this being the abbreviation of Moeda de Ouro, or Gold Piece of Money].

Thus 2⅔ Lisbonina = 72s.
1⅓ Lisbonina = 36s.
1 Lisbonina =27s.
⅔ Lisbonina = 18s.
½ Lisbonina = 13s. 6d.
⅓ Lisbonina = 9s.
¼ Lisbonina = 6s. 9d.

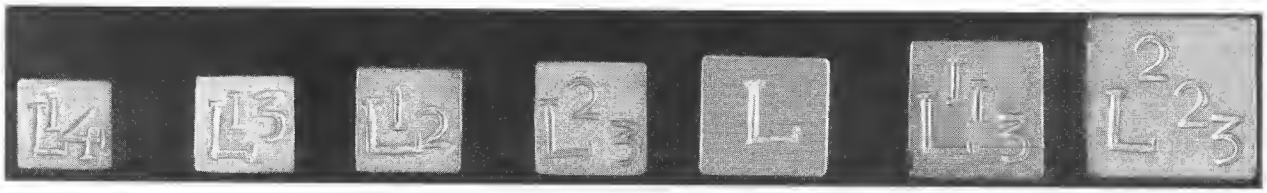


Fig. 3. ⮝⮝ Seven coin weights for the Lisbonina, from an Italian box for Portuguese coins.

The weights, Fig 3, from a cut-from-solid box from Genoa c.1800 show the Lisbonina sequence.

Unknown maker, Birmingham (?) Fig. 4.
Sliding weight made of brass. Beam of steel with two notches marked S on their right sides. Key-hole hanger identical to the ones in folders made by TB, (identified as Thomas Bourne of Birmingham.)

The first assumption was that the notches indicated the sliding weight position for One Sovereign and Half-Sovereign. Actually these coins are too heavy, and the beam tilts beautifully under a Half-Johannis (18s.) and under a Quarter-Johannis (9s.). The maker omitted, for some reason, (possibly lack of relevant punches) the stamping of 18 and 9 on the left side of the notches, but S certainly means Shillings and not Sovereign.

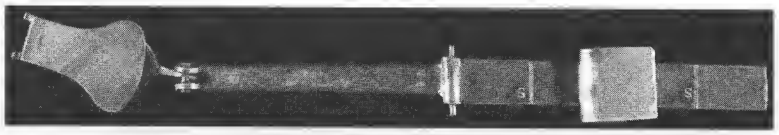


Fig. 4. ⮝⮝ Beam from a folder for the Half-Johannis and Quarter-Johannis. The slide is unusual in not being tightly wrapped round the beam.

An example by DeGrave Short & Fanner, for the Double-Johannis, Johannis and Half, was described by A J Crawforth in EQM, 2354, with my added comments on page 2405. This example was made after 1845 for export, long after the English had stopped using Portuguese coins.

Anthony Wilkinson of Ormskirk, (Late of Kirkby), Near Liverpool. Fig. 5.
Brass beam graduated 0 to 12 (grains). Special double turn for weighing four coins:
the Guinea (21s.), Half-Guinea (10s..6d.), Third-Guinea (7s.) and the Half-Johannis (18s.)

This folder was made after October 1797 (the date when the Third-of-a-Guinea was first minted) and before 1801 (the date of Wilkinson's death) and co-incidentally when gold coins almost completely disappeared to pay the troops during the Napoleonic Wars. Would this mean that during the period 1797 to 1800, the foreign coin most commonly used in England was still the Half-Johannis? Paper money was the alternative.

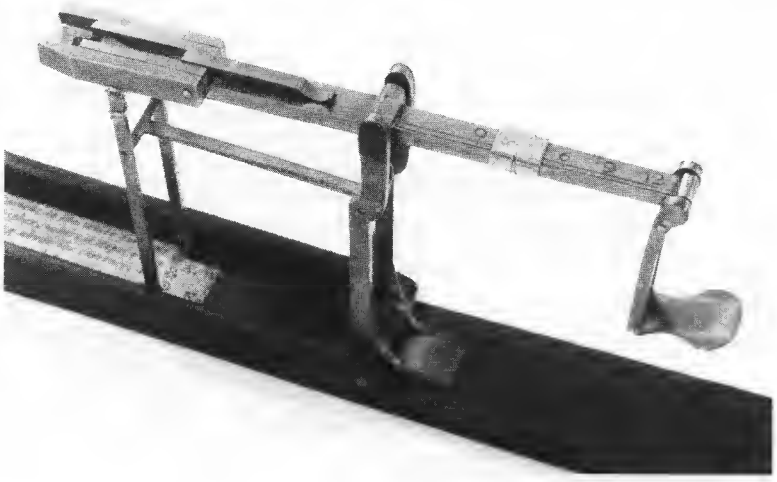


Fig. 5. ➢➢ The label has been cut across, but the name A WIL[KINSON] is visible. The pillar design is characteristic of Wilkinson.

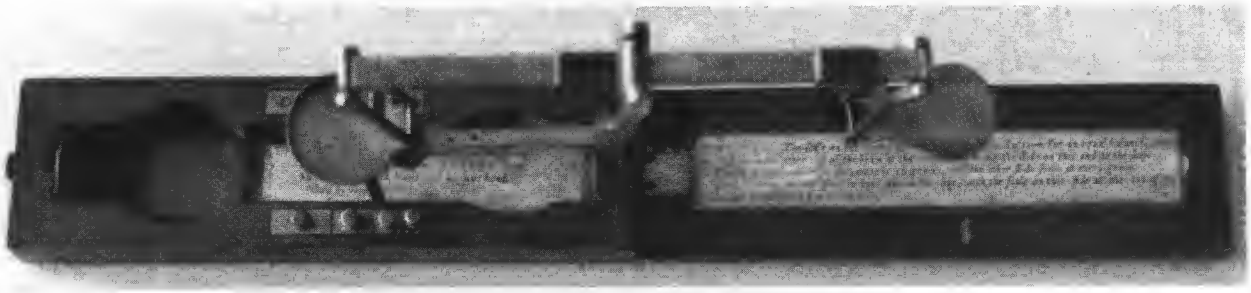


Fig. 6a. ⮜⮜ Another Anthony Wilkinson folder, intended to weigh any of the eleven coins in circulation. Wilkinson developed so many variations, apparently never satisfied that he had found the perfect answer. The use of two slides is very rare, the left-hand one functioning as normal, to indicate grains of gold lost, and the right-hand one operating as an extra weight of 1/2dwt.

Anthony Wilkinson, of Ormskirk, Lancashire, Figs 6a, 6b & 6c.
Pan and plate folding balance, with a set of 6 rectangular knobbed weights of 6, 5, 4, 3, 2 and 1dwts (pennyweights) as described by Lou uit den Boogaard in EQM, 627. By moving the second slide (on the same side of the fulcrum as the coin) out of its neutral position next to the hanger and towards the fulcrum, an extra 1/2dwt could be added. As Michael Crawforth noted, this balance could weigh any gold coin in pennyweights and grains, so could weigh any of the eleven current English or foreign gold coins.[3] The pan has exceptionally high sides to retain the tall, thin weights.

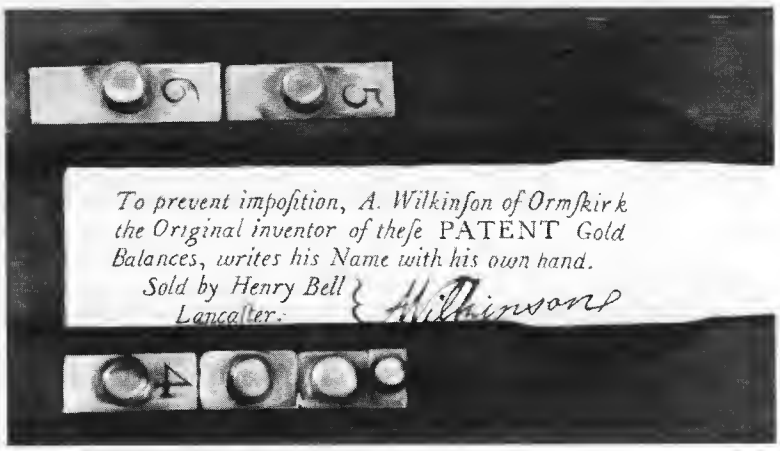


Fig. 6b. ⮜⮜ The example described by the late Lou uit den Boogaard was personally signed by Anthony Wilkinson. Both he and Hamlet Bell resorted to signing their folding gold balances to reduce fraud. Made after 1786, when Wilkinson moved to Ormskirk.

N.B. In EQM 672, Michael Crawforth also reported a five-turn folder attributed to Anthony Wilkinson which, by careful flipping of the turns, could weigh eight of the English and Portuguese gold coins current in England, (omitting the largest and the two smallest coins). Fig. 7. Only one example of a five-turn folder is known, probably reflecting low sales. Who could remember which turns were in and which were out for the eight weights?

Fig. 6c. ⮜⮜ The elegantly tapered weights from the box above. The weights are difficult to fit into the tight slots, and only by tapering them could they be pushed in without damaging the box. Shown full size.

The example shown in Fig. 6 with individual pennyweights also had its disadvantages, in that the customer needed to know the correct weight of each of the 11 coins. Contemporary equal-arm scale boxes were normally sold with a chart of coins and weights to help the bewildered customer!

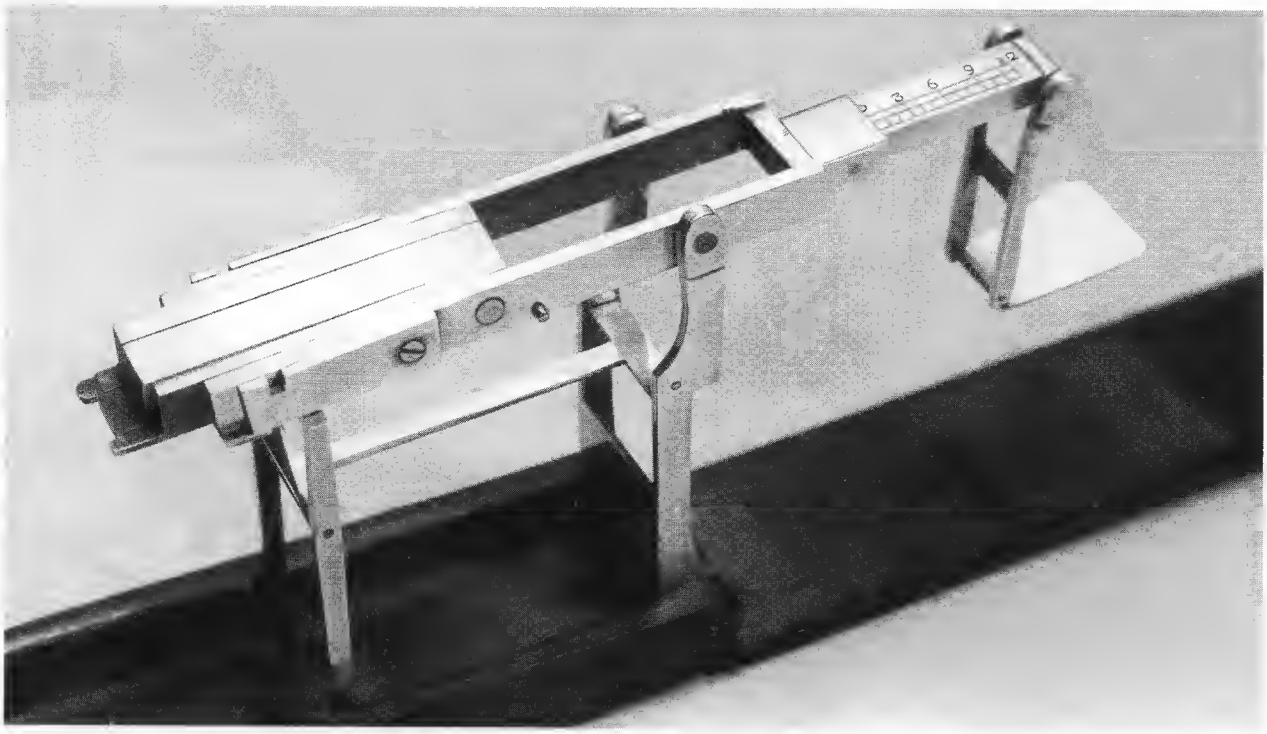


Fig. 7. ⩓⩓ The five-turn folder discussed by Crawforth. Note that the poises go past the fulcrum, making the mathematics of the various combinations exceptionally difficult!

Jesse Ramsden, London

A folder of mine, in a mahogany case with a sliding lid, signed twice by Ramsden inside the lid, has a beam marked 5dwt, 2dwt 12grs and 1dwt, and a moving poise graduated 0 to 12 (grains) indicated by a slide. Using the marks on the beam and those on the poise, coins of 5dwt 8grs (the Guinea) 2dwt 16grs (Half-Guinea) and 1dwt 8grs (Quarter-Guinea) could easily be weighed.

Folders made by Ramsden are unique in their design, he being a scientific instrument maker, not a scale-maker. They are of the moving-poise type. The moving poise indicates the graduations on the beam, and the moving poise is itself graduated for 24 grains indicated by a tiny slide on the poise.

In his book *Weighing Coins*[5] Michael Crawforth shows a picture of one of Ramsden's folders. The beam is marked for the Portuguese coins as well as for the Guinea, Half-Guinea and Quarter-Guinea (but not the Third-Guinea since the folder was made c.1780, well before the Third-Guinea was minted.) The folder has to be pulled up manually from the side-opening shagreen case. Fig. 8.

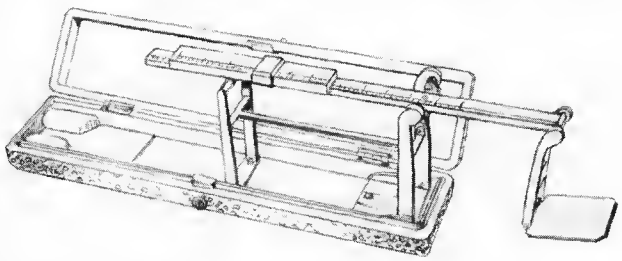


Fig. 8. ⩓⩓ Jesse Ramsden made folders for the Guinea, half and quarter, and a hydrostatic version for weighing them in air then in water, to enable the user to determine the precise amount of cheap metal mixed with the gold when making the counterfeit coin. Additionally he made this version for weighing the current Portuguese coins. Ramsden died in 1800.

Drawing by Michael Crawforth

Fig. 9. ⩓⩓ The beam from a folder by Jesse Ramsden, showing the graduations in shillings for the Johannis, Moidore and Guinea. The tiny slide on the moving slide is clearly shown. Ramsden had Francois Jecker in his workshop, and Jecker took the idea of folders back to Paris where he and his brothers subsequently made French folders for many years.

Another example is housed in a mahogany box with a sliding lid, with the beam marked in shillings with the positions for ten coins (the £3..12s. being omitted). Fig. 9.

A hydrostatic version appeared some years ago, for weighing Guinea, Half and Quarter, as well as the Moidore, Johannis and their sub-divisions, as mentioned by Crawforth in *Weighing Coins*,[5] page 8. The aim of such hydrostatic balances was to enable the user to determine whether a gold coin of correct weight contained some cheap metal.

Johann W Herbertz, London. Fig 10a, 10b, 11 and 12.

This folding balance was put into the Essener Auction of 23 May 1990. It does not carry any maker's name but can be firmly attributed to J W Herbertz because of the typical gilt decoration on the lid. Figs 10a and 10b.

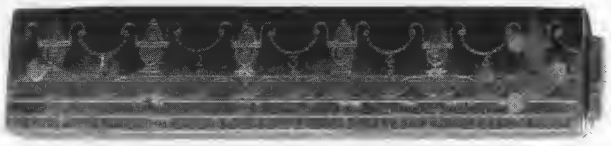


Fig. 10a. ⩓⩓ Although J W Herbertz spent most of his working life in London, he retained the elegant style of his home district of Solingen, north of Cologne. He impressed the ebonised wood with gilding in a classical style, and often put a six-inch rule along the front edge.

Fig. 10b. ⩓⩓ A second example of a box by J W Herbertz, showing that he liked variety.

Although the auction catalogue mentioned that the folder was made for weighing the Guniea, Half-Guinea or Sovereign, its beam tilts under a weight of 94 grains = 3dwt 22 grains = 6.17 grams, and at one-third of that, 31⅓ grains = 1dwt 7⅓ grains = 2.06 grams. My efforts to identify the corresponding coins remain unsuccessful. Herbertz came to London c.1763-66 but was no longer in London tax-books by 1779. This gives a tight time-frame of about thirteen years in which this folder was made. See Fig. 11.

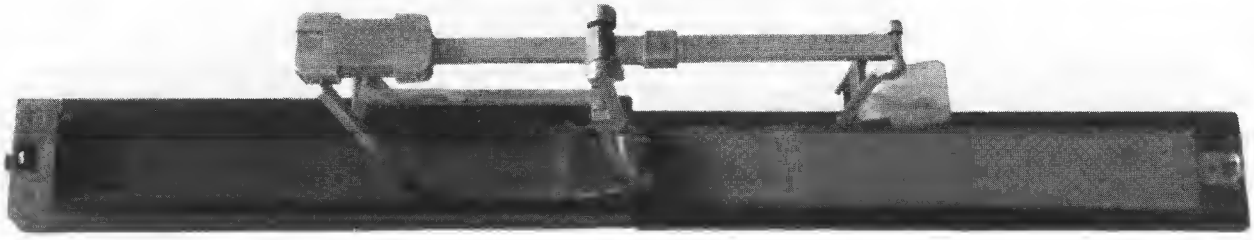


Fig. 11. ⩓⩓ Johan Wilhelm Herbertz made this folder with its distinctive shape of poise. The brass beam is graduated 0 to 12 (grains) for deficiencies. Note that every number is individually engraved, not just 0, 3, 6, and 9 as with English makers.

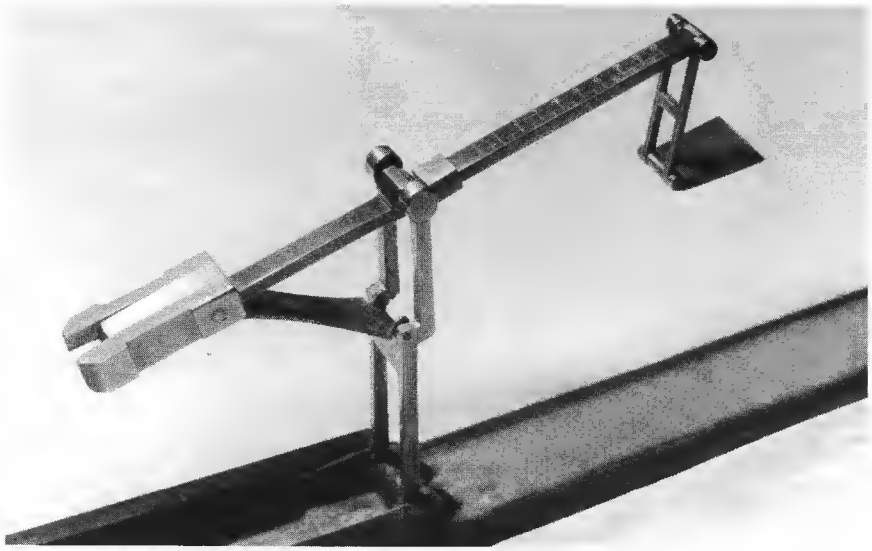
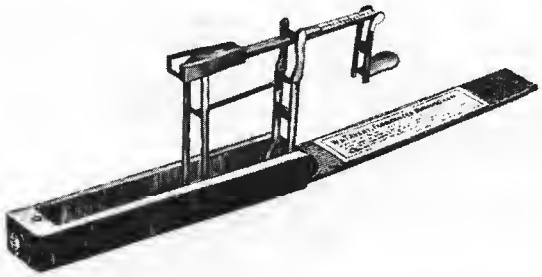


Fig. 12. ➢➢ Another folder by J W Herbertz, with the distinctive poise design. Note the circular dust-cap on the top of the pillar. Again he engraved every number. The odd feature is the diagonal support for the beam, barely adequate for its job, but easy to make.

N.B. 1 dwt 7⅓ grains could be the weight of a very light Third-Guinea (the full weight being 1dwt 18½ grains). Withers shows surviving 7s. weights ranging in mass between 1dwt 7grains and 1dwt 19 grains.[6] However, the Third-Guinea was first minted in 1797, well after Herbertz left London, so in this case, Herbertz must have been designing for the Quarter-Guinea of 1762.

Herbertz made several variations on his folder, the version from the Essener Auction having the standard English linkage, but one in another collection having a diagonal brace supporting the beam. See Fig. 12.

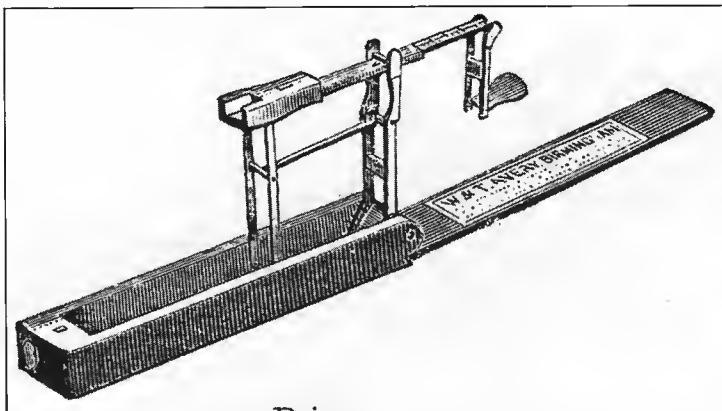


900.—SMALL POCKET BALANCE,

For Weighing Coin, Sovereign Balance, to weigh 1 Sovereign and ½ Sovereign, with Slide to show number of grains deficient through wear. Doubloon Balance, to weigh Spanish Doubloons or Onzas, and ½ Doubloons or ½ Onzas, with Slide to show the number of grains deficient.

Sovereign Balances	9/6 each.
Doubloon ,, ...	12/- ,,

Fig. 13. ⮝⮝ W & T Avery catalogue of 1880. The amount of brass used to make the Doubloon folder was about twice as much as was needed to make a Sovereign balance, so it is not surprising that it was more expensive.



No. 900.

Pocket Sovereign Balance in Mahogany Case, to weigh Sovereigns and Half-sovereigns, with slide to show number of pence deficient through wear.

This balance meets the requirements of the circular issued by the Bank of England, on March 29th, 1897.

Price **16/-**

For Napoleons and Half-Napoleons **16/-**. For Turkish Lira and Half-Lira **16/-**. For Egyptian Lira and 50 Piastre **16/-**.

Fig. 14. ⩓⩓ W & T Avery Ltd catalogue of 1906. Although the Bank of England put out a circular, the use of Sovereigns was reducing in Britain, and by the beginning of the First World War had stopped. However the Sovereign was still much used in other countries so Avery was really targeting the export trade. See Fig. 17. The same folders were offered in the 1909 catalogue.

Export to foreign markets

Acknowledgement should be given to W & T Avery (Ltd.) for mass-producing pocket balances for exportation from at least the early 1850s. As their catalogues indicate, folding balances were made to weigh Spanish Doubloons [or Onzas] and Half-Napoleons, Half-Turkish Lira and Half-, Egyptian Lira and Half-(50 Piastres). Fig. 13 and 14. [Although technically the Onza was a trade ounce, the word was apparently used colloquially to denote the Doubloon.]

No folders have been seen which would weigh Napoleons, Turkish or Egyptian Lira, unfortunately. However, during the last century the Sovereign and its Half were current in the Middle-Eastern countries so Sovereign folders were marketed together with the typical small Turkish cruciform rockers. Fig 15.

W & T Avery, Birmingham. Fig. 16.

The folder for the gold Doubloon carries a label printed in Spanish "*W & T Avery, Fabricantes, Birmingham, Balanza superior para oro, arreglado al peso espanol. Para pesar una onza se dobla la Balanza hacia el estremo, y para media onza hacia el centro; para acertar la falta del peso, se debe mover el tubo cuadrado hacia la estremidad. N.B. Antes que se currasyla cajita, se debe encurrar la platilla chata.*" It gives the usual instructions for using the turn and the deficiency slide on the beam graduated in grains, the design having been maintained for 125 years.

Fig. 15. ⩔⩔ Cupro-nickel cruciform rocker by Iskender Arabian of Constantinople, for the seven coins used in the Turkish-Greek empire. Each graduation is marked in Arabic and Western script. The handle is lying flat to the left, but when vertical, it is held between finger and thumb. The dial has to be rotated to the correct graduation before use, and can be rotated a little bit to show the deficiency.

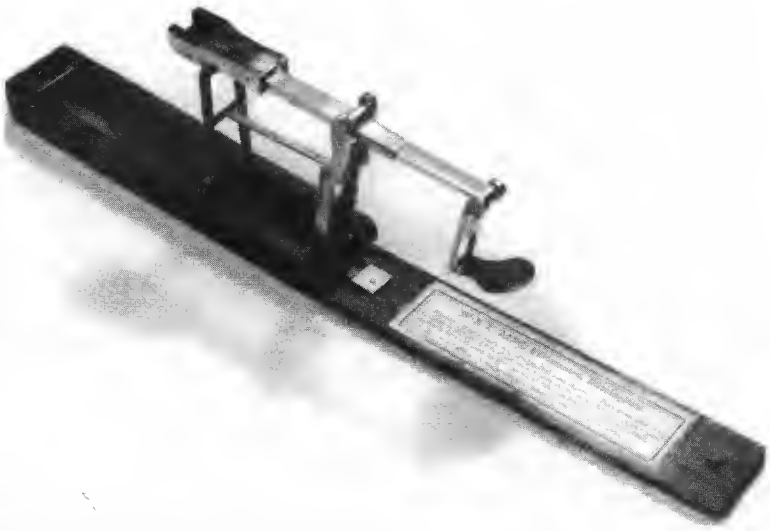


Fig. 16. ➢➢ W & T Avery folder for the Doubloon and Half-Doubloon. Note the elegant shape of the poise. It is thought that Avery's bought in folders, as they did not make them. The maker is not known.

Recently a folder by W & T Avery appeared on the market to weigh the Half-Doubloon and the Quarter-Doubloon only, with the same label as shown in Fig. 16.[7] This version is not shown in catalogues.

John Smith, London, Fig. 17.
No records exist about this maker.[8] The only folder known so far is one for the Doubloon and Half-Doubloon. It carries a label in English giving some short instructions and the maker's name. Presumably it was made for the English market.

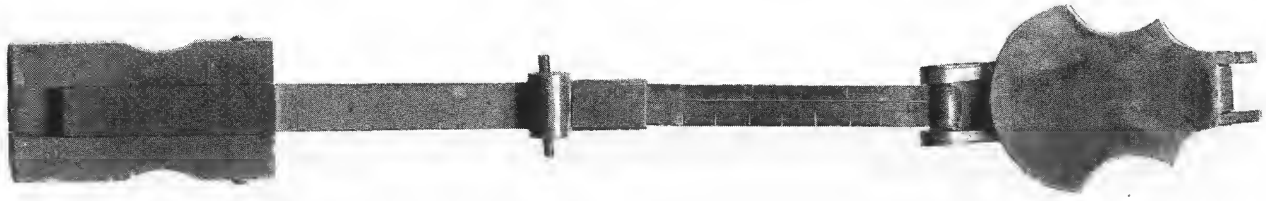


Fig. 17. ⮙⮙ John Smith's beam of a folding gold balance. Note the huge coin-plate, essential for the Doubloon.

W & T Avery, Birmingham, Fig. 18.
Sovereign folder used in Syria.

Over the original label is pasted the label of the distributor, printed in French and hand-written in Arabic, *Asswad & Berbari, Beyrouth-Syrie*. Prior to the First World War, 1914-1918, and the constitution of Lebanon, Beyrouth was in Syria, a province of the Ottoman Empire.

All these folders are extremely rare, and are well-worth looking for, demonstrating as they do, the international exchange of coins and of the scales needed to check them.

Fig. 18. ⮙⮙ W & T Avery folder with the label of Asswad & Berbari of Beirut (to give the Western spelling) stuck over the Avery label. For Notes & References pass the Beginners Guide, and continue on page 2573. ➢➢➢➢➢➢➢➢➢➢➢➢➢➢➢➢➢➢➢➢

Beginner's Guide

BY D F CRAWFORTH-HITCHINS

Vocabulary

This is a very confusing area! The terminology varies according to whether the user is American, British, a manufacturer, an inspector, a collector or an academic! ISASC has gradually settled on a reasonably standard vocabulary.

What is a Scale?

The essence of a scale is that it informs the user of the mass of the load. The mass is defined in units such as pounds, grammes or drams. The accuracy varies from the wildly vague to the very precise, but never (in practice) provides the perfect answer. All scales have built-in compromises, to give economy of manufacture, speed of use, provision for repair, or convenience in transporting.

Collectors might talk about a "precise postal scale" but that is sacrilege to a scientist! A good postal scale might be accurate to 2 grams, but a precision balance might be accurate to a hundred-thousandth of a gram in the mid-19th century. Modern electronic scales used in shops provoke scorn in Weights and Measures Inspectors, being so much less accurate than the equal-arm beams on a pillar, used in the 19th century.

Immediately we are into a controversial area. Are scales singular or plural (the word deriving from scala, a pan)? When is a scale better called a balance? When the resistant does not provide balance (as with a spring) why is it still called a balance? Let us just accept that historically the terminology developed without much logic, and settle on usage as it is, without attempting to apply logic too closely!

Many "scales" merely inform the user as to whether the load is up to that expected or is below that expected, that is, a weight-prover. Technically these are not scales, but as they are so close in function, they are classified as scales by collectors. Sovereign rockers are weight-provers.

Scales can be used to define categories other than mass. They can be harnessed to other devices to define strain, measure pressure, test moisture-content, count objects or read out as price. Again, they were frequently classified as scales and were made by scale manufacturers.

Classification

There are two main ways to divide scales, either by the design principle used or by their function. Because one type of scale can be used in such a variety of trades, it is very difficult to define its use by function. Is a flat-faced spring balance for weighing fish or luggage? The functional categories such as coin-, postal- or diamond-scale, are useful to collectors but do not distinguish between design principles.

Categorizing by design principle ought to be clearer, but, because scales frequently utilize two principles combined, as in a half-roberval and steelyard scale, this method too has its limitations. We can help ourselves by identifying the resistant; is the load balanced against weights, a spring, a poise (a lump of no specified mass), or something else?

Nationality

This field is more obvious, as long as the manufacturer and the user lived in the same country. But scales were traded world-wide, and the products of one country influenced designs in other countries, such as Chinese craftsmen taking Western designs and producing their own variations.

A problem provoked by history is "What do we call a country that has belonged to different states at various times?" It seems impossible to satisfy everybody, or to be politically correct all the time. Rely on goodwill, and recognize that no insult is intended if an old name is used. The Netherlands is typical, in that it has been independant or occupied intermittently over the years. It shares many characteristics with Belgium, and together they may be called the Low Countries.

History

It is easy to assume that the simpler the scale, the earlier, or the more primitive the manufacture, the earlier. This approach has pit-falls, and "first ever" is a phrase that produces many an ignominous correction! Naturally, academics would love to know for certain when springs were first reliable enough to be applied to weighing, or when somebody

first thought of "instant read-out". Entire books have been devoted to such linear developments.

Just be a little bit cynical when informed that "This is the first". More precisely, the design principle probably started far earlier than you assumed, and your example was probably made much later than you assumed! That has certainly been the experience of the author!

Technicalities

The accuracy of a scale depended on the craftsmanship, the materials from which it was made and how and where it was used. Some countries had much stricter regulations than others, so a scale considered good enough for weighing expensive tobacco in one country would only be good enough for weighing cheap sugar in another country.

Comparisons are made in ISASC publications, not critically, but to show variety. Some countries consider adults can look after their own interests; other countries make laws to protect everyone including the weak-minded. Some countries banned the Roberval counter scale, as it had so many friction points. Some countries banned the bismar, as it was so difficult to use accurately and was so easy for the trader to manipulate to his own advantage.

Beam-ends

Beam-ends are a compromise between crisp accuracy, tough long-lasting parts, ease of manufacture and tradition. The shape is often an indication of the country of origin, either of the scale or of its maker. A few variations are shown.

These beam-ends are shown very approximately in date order, starting with a reliance on the flexibilty of cords, developing sharp edges between loop and end, getting the contact point sharper and more precisely located, protecting the bearing from dirt, and by the late 19th century, adjusting the position of the whole bearing by minute amounts. Beam-ends show various attempts to solve the problem of getting and maintaining the end-pivots equidistant from the fulcrum, the problem of getting the smallest possible contact between hanger and beam without having it break, the problem of adjusting the knife so that it was in exact alignment, and the problem of keeping the bearings clean.

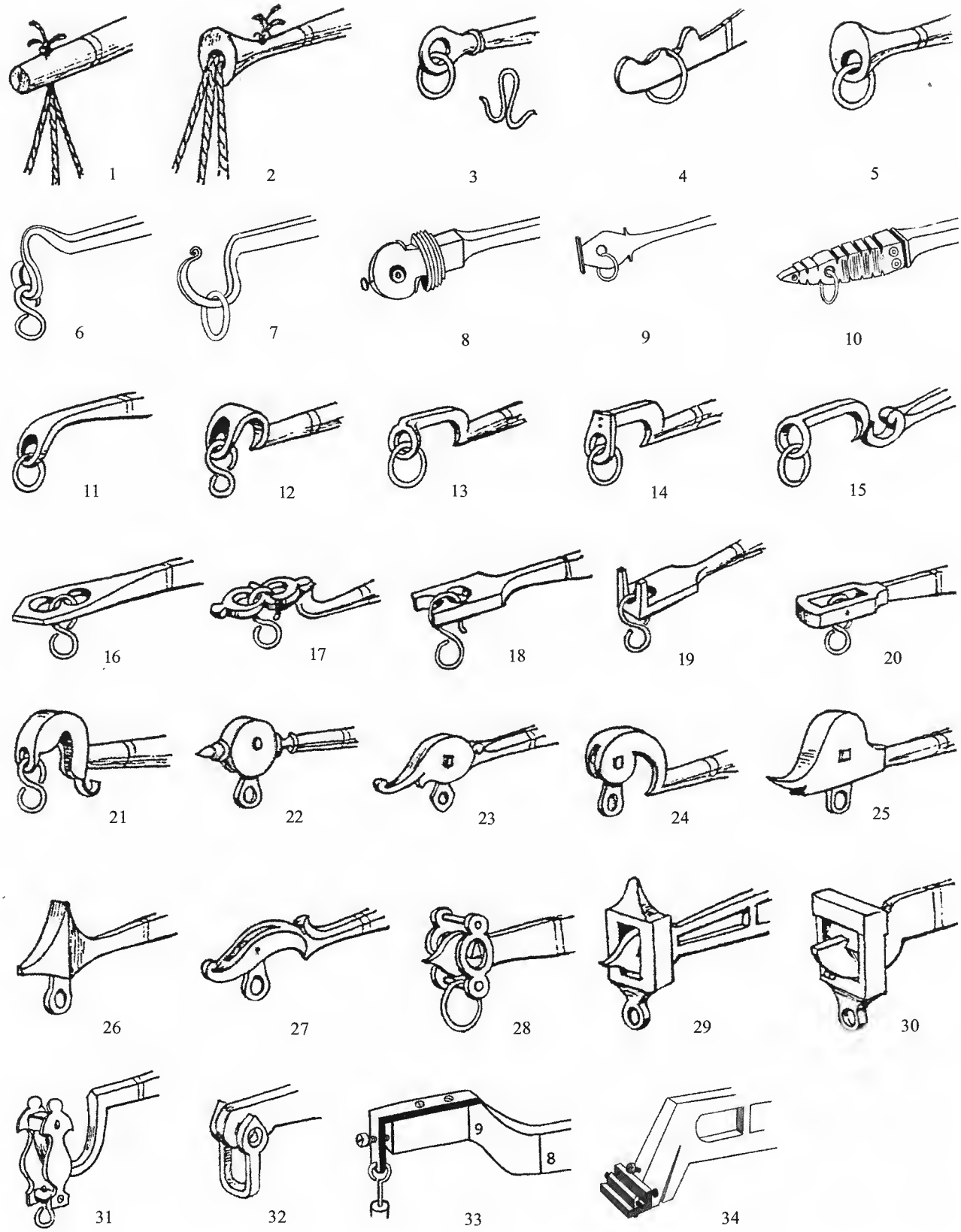
Some beam-ends were used in one area, some were universal. Most nations had their favourites, and that nationality has been attached to that design. The Spanish were unusual in copying with amazing skill the ends used by other nations, and having only no. 25 peculiar to themselves.

From about 1875, beam-ends for more modern precision balances were concealed in elaborate adjustment systems with up to eight screws to move the planes and bearings minutely. Each manufacturer developed his own design, and nationality was no longer relevant. The use of agate planes necessitated the use of protective boxes, and the need to replace the planes regularly involved neat access and the ability to adjust the angles relative to each part after the glue (wax) had set.

Cataloguing

This is a difficult area for all curators and collectors. Modern developments have made it simple to photograph the object and record any words and marks put on by the maker. Some collectors like to file under name of manufacturer, some under purpose, but the most precise catalogues use the method applied here, mechanical type. The headings below are based on the classification system developed by the author for the use of curators of museums.

1. Equal-arm beams
2. Equal-arm beams with linkages: Robervals, Berangers, Phanzeders, US Torsion or Schickert's principle, fan scale, trip scale
3. Equal-arm beams with oddities: chain resistant, captive weights, wire pivots, locking arrestment
4. Straight unequal beams: steelyards, simple, turn-over, (Roman balance), sliding, weigh-beam
5. Straight unequal beams, steelyards with turn-over poise folder & bread, weight lifting, telescopic, canon-ball
6. Straight unequal beams: steelyards with bifurcated beams, compound lever platform scales, two pan (counting)
7. Straight unequal beams: bismars, moving load
8. Bent, curved or circular beams: pendulums, turn-over
9. Spring, helical:, cylinder shop scales, external springs, dial-face, cone springs
10. Spring, flexure: elliptical, leaf-spring
11. Oddities: magnets, hydraulic, electro-magnetic, Caledonian scale
12. Mixtures. This could be the biggest category.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III
2573

1. Cord pivot end. Often used on wooden beams. Used from 2600 BC to the 1800s AD.
2. Trumpet end, or lotus end. Used on wooden, bronze and electrum beams by the Egyptians after 1550 BC.
3. Ring-and-hole end. or Roman end. Used on bronze and brass beams.
4. Hook end.
5. Renaissance trumpet end. Drawn by Durer. Much used in Cologne 1500s-1600s.
6. Wrought-iron loop end. Blacksmiths commonly made middle- and large-sized scales for their local community.
7. Wrought-iron hook end. Blacksmiths drew out the end of the metal and curled it in various ways to form a hook.
8. Kerala end. Heavy cast brass. Variations used throughout India
9. Ashanti end. Cut from sheet brass. Usually incredibly frail. Often a piece of string served as a fulcrum.
10. Indian Ocean end. Used from Madagascar to Bahrain to Thailand. Sometimes of cast-brass, sometimes of sheet brass.
11. Nuremberg end. Used as late as the 1700s.
12. English swan-neck end. Subtle variations of this shape were used in Cologne, Spain, Amsterdam, Antwerp, and Berg & Mark
13. German swan-neck end. Particularly used in Nuremberg.
14. German rivetted swan-neck end.
15. Nuremberg swan-neck end.
16. Double-hole end. French 18th C especially Paris & Lyon.
17. French double-hole end has a knife-edge between the two holes. Especially used in Paris.
18. Open double-hole end.
19. Horned hole end.
20. Open box end. Used in Upper Italy 18th-19th century, Spain and Germany.
21. Boxed swan-neck end.
22. English box end. Copied by the Spanish and the Chinese.
23. Nuremberg box end. Also used in Vienna in the 1800s & Barcelona.
24. Swan-box end. Used in Vienna and Berg & Mark.
25. Spanish box end.
26. Cusp box end.
27. Berlin box end. Used in Spain, Berg & Mark and Austria.
28. Dutch end invented before 1615.
29. English Sharkey end, or Agate box end, patented 1857. Much used because it protected the fragile agate so effectively.
30. Stirrup end.
31. Inverted swan-neck end.
32. Shackle end.
33. Loose plate end. A screw was used to adjust the plate minutely.
34. Slit beam end. Adjusted by tightening the screw in the end of the beam. Second quarter of the 19th century. The hanger is not shown, as it conceals the adjustments.

Cataloguers will probably wish to include in their description,

a. Purpose: shop, grain, gun-powder, silk, dairy, bread, etc, etc.
b. Mechanical type, as above. Type of beam-end.
c. Nationality, often deduced from studying old auction catalogues.
d. Manufacturer or retailer. The address might be obtained from other sources.
e. Weighing capacity, ie, graduations, Class stamped on beam.
f. Weights: type, denomination.
g. Date, exact or deduced, with supporting evidence.
h. Main dimensions, enough to differentiate between two similar scales.
i. Marks
j. Materials
k. Interesting features, story associated with obtaining the scale, superficial decoration.
l. Cost with date of purchase.
m. A number allocated to that individual scale, and recorded on the scale in a non-permanent way, in an unobtrusive position. (One collector, now dead, used to stick a large white label on the top-surface of each scale, with a number in large black letters. It was hard to view his collection intelligently with such a dazzling diversion!)

A beginner may find it difficult to fill in many of these headings, but, if a space is left for their eventual use, the learning process will lead to their completion in many cases.

Weights

Scale-makers supplied weights to suit their customers, so the weights were sold separately in many instances. If a grocer wanted weights from 7-lb down to ¼oz. to go with his sugar scale, that was what he bought. But his neighbour might buy weights from 56-lb down to 1-lb, of exactly the same design, to sell seed-corn or flour by the bagful. So talk of "Complete Sets" can be nonsense. Similarly, a boxed scale with 2ins-diameter (50mm) pans might be sold with coin-weights or with apothecary weights, or with both, according to the needs of the customer.

Some weights were made with built-in tolerances, to allow for a profit, to allow for wear and tear, to allow for moisture-loss when baking bread, or to dupe the customer. Inspectors fought their wars against such practices; duplicitous individuals evaded scrutiny.

It helps collectors to use one system as the comparison for all their weights, so ISASC converts all units to grams [grammes]. In the past, many compilers used grains or avoirdupois ounces as their standards, but this led to confusion. No attempt is made here to be complete, but commonly-used systems are shown below, particularly those encountered by American and British collectors.

1. Avoirdupois, English & American trade
2. Kilograms, Grams
3. Troy pennyweights, grains, apothecary (drams, scruples)
4. Carats and Carat-metrique
5. Gros, French
6. Tola, Indian
7. Coin-weights

When the reader has digested all this information, ISASC recommends the use of *The Handbook of Old Weighing Instruments* by M A Crawforth, which covers more ground than this brief guide.

1. Equal-arm beams

Beam	Straight. Equal arms
Resistant	Weights. Fixed pivot
Resistant	Not attached, ie. loose
Fulcrum	**Central. Fixed pivot. MAIN FEATURE.**
Load	Fixed pivot. Pan below beam
Stabilised by	Suspended from hook, fingers or pillar. Long cords, rods or chain
Graduations for equal units	According to weights used
Common name	Equal-arm scale, weigh-beam (USA), even arm scale (USA)

A straight beam with a fulcrum exactly in the middle, with the tips of the end bearings exactly in line horizontally with the tip of the fulcrum, ideally. Beams can be triangular, drooping, curved or cut-away to give lightness. The crucial factor for a straight beam is that all three pivots have their point of contact in a straight line, and may have tiny correcting mechanisms to ensure that they stay in a straight line.

It is likely that equal-arm beams were the first type of scale used. Paintings show their use from c.2600 BC. They are extremely practical for general weighing (from weighing canons to weighing diamonds), and have never been entirely superseded. It is often difficult to identify the use to which it was put, so peripheral clues help, such as the type of container, the units of the weights, the size or shape of the pans, or the label.

Any deviation reduces accuracy. Makers liked to adjust the beam by making one arm longer than the other, (so a heavier pan might appear correct by shortening the arm); inspectors wanted the arms exactly the same length.

Some cultures had a tradition of putting the fulcrum higher up than the end bearings (Indian, Japanese, Andean, Ashanti) but that made one end drop rapidly and stay there even when the weights balanced the load. Some countries, notably USA, used equal-arm beams very rarely, compared with their use of other type, restricting their use basically to bank, laboratory, and prescription scales.

The greater the friction between the bearings and the hanging parts, the less sensitive the beam was, and at its most obvious, Japanese money-changers would tap the fulcrum smartly with a hammer to ensure that the beam had swung.

Hand-held beams are easy to use to about a twelve-inch (300mm) beam. Larger beams were hung from a hook screwed into a beam in the ceiling, or on the top of a pillar. Pillars had the advantage of being adjustable, so the load and the weights could be applied, then the last inch of lift could be applied by pressing a lever or pulling a string. This brought the lighter pan up to swing freely, and the weights could be increased or decreased as necessary.

Although most equal-arm beams hung from a suspension point, a few sat on a saddle mounted on top of a pillar. Grocers' scales, precision balances and coin scales were sometimes arranged to rock, with their pointer normally pointing down, passing a datum point or going through a sight-hole. Occasionally the pointer rose up from the beam, and swayed in front of a graduated arc.

Beam-ends come in many different designs, some because of national traditions, some due to technical improvements. The simplest had merely a hole drilled through the beam, the most elaborate could be adjusted in every direction with miniscule screws. Attempts were made to utilise the bend of a silk cord, the toughness of ruby, the twist of a wire, and the roll of aluminium on plastic.

Draughts and warm air-currents affect fine balances, so glass cases have been put round balances since the 15th century. Glass-cased balances came into more general use in the 1820s, and many refinements have been made since, to give ease of access, a good view of the graduations, a vacuum seal or to reduce the frequency of opening the case.

Because precision balances are required to give repeatable results with the smallest quantities, many refinements have been added to the basic concept. To avoid opening the case too frequently, weights can be added from outside the case; the load can be moved from one end of the beam to the other automatically; the finest divisions are read through a telescope; the bearings are protected by being detached from their planes.

Fig. 1a. Viking hinged coin-scale with circular bronze case c.1000 AD. Beam shown half opened.

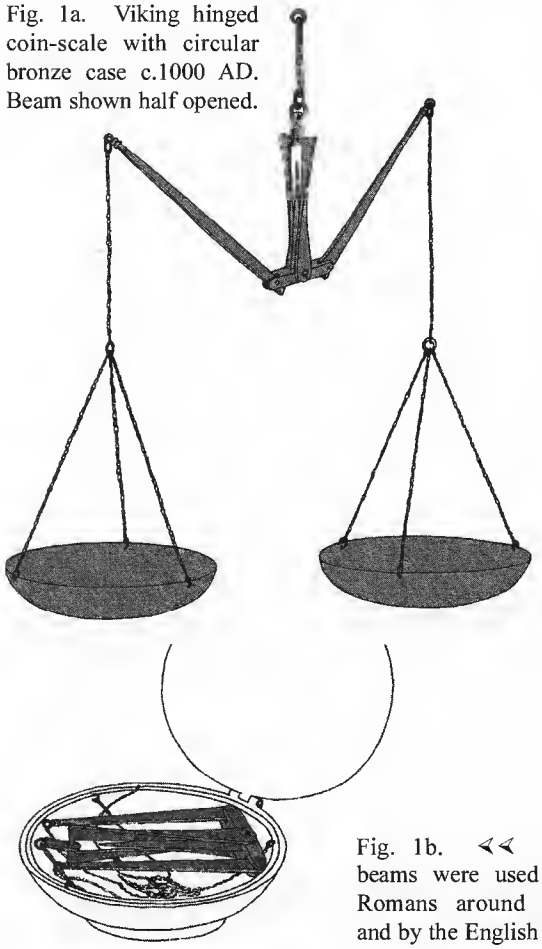


Fig. 1b. ≺≺ Hinged beams were used by the Romans around 200AD, and by the English c.1780.

Fig. 2. ➢➢ German Berg & Mark coin-scale c.1770. Piercing was even more elaborate in Persia.

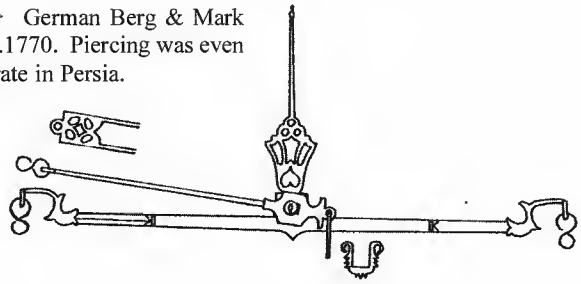


Fig. 3. ⩛⩛ English folding gold balance c.1780. It is "folding" in that the lid of the box pulls up the pillar into the working position by a pin near the hinge, and conversely folds it down when shutting. Brass box and weights with off-set knobs.

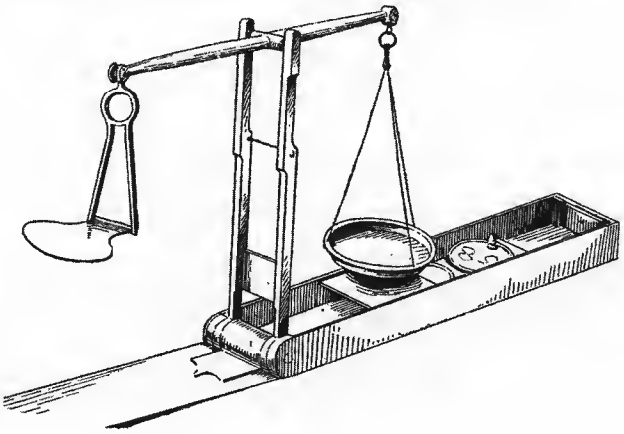


Fig. 4. English general purpose fine beam 4-16ins (100-400mm) long. Made 1740-1900

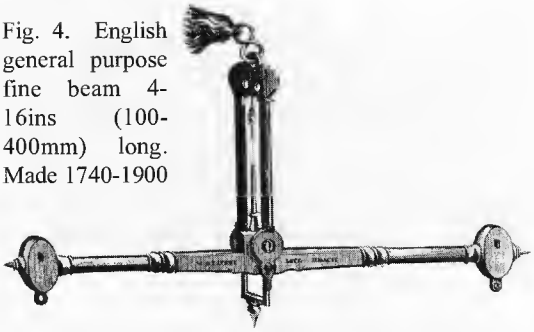
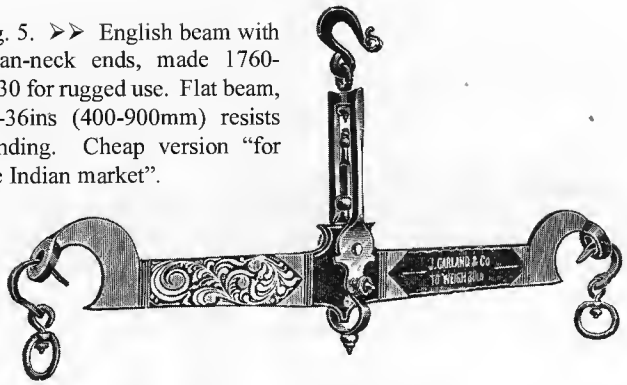


Fig. 5. ➢➢ English beam with swan-neck ends, made 1760-1930 for rugged use. Flat beam, 16-36ins (400-900mm) resists bending. Cheap version "for the Indian market".



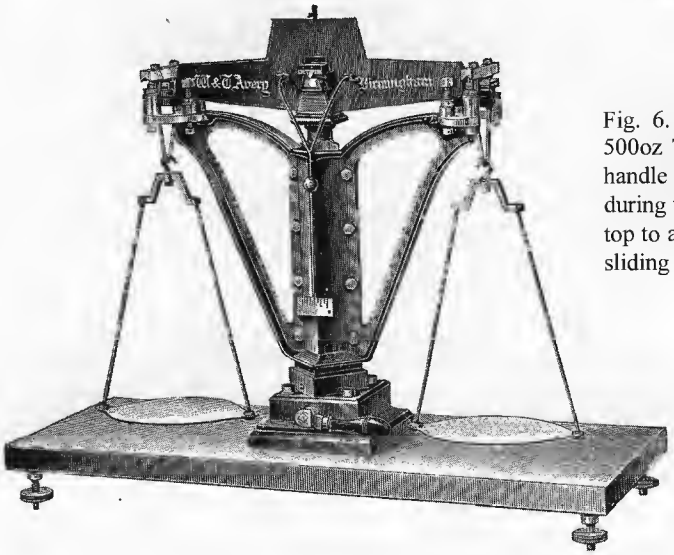


Fig. 6. ➢➢ British inspectors' indoor beam, c.1900. capacity 500oz Troy. Very rigid V-shaped arrestment frame. The lever-handle at the bottom of the pillar lifts the beam clear of the frame during use. Continuous knife-edges. Nickel-plated. Flag at centre top to adjust the balance of the beam minutely. Air-tight case with sliding doors.

Fig. 7. ➢➢ English person scale hung from a hook in the ceiling, 1875. The weights were put on the scale first, so the jockey did not fall to the ground when he sat on the scale. The weight plate touched the ground until enough weights were removed. The Dutch ends were formed by the end-plates being screwed together across the beam, a method developed by 1615.

Fig. 8. ➢➢ English portable Bullion or Bank scale. Lattice beam 10-18ins (255-400mm). Lever lift. Agate bearings. Troy weights in fitted holes in the drawer. 1860-1930.

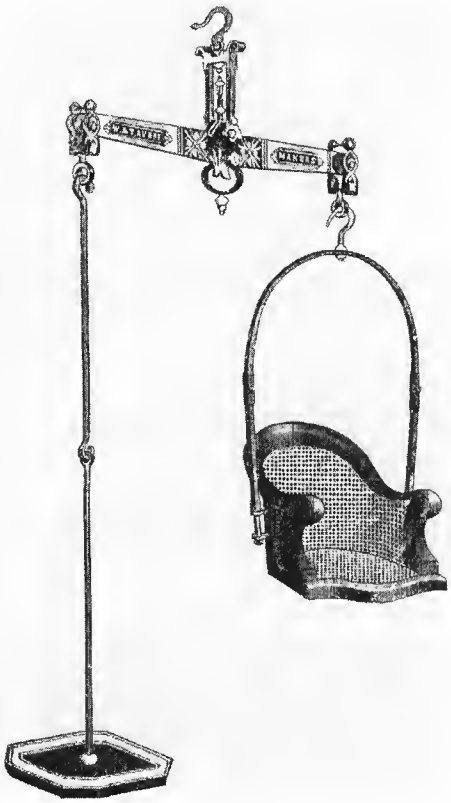
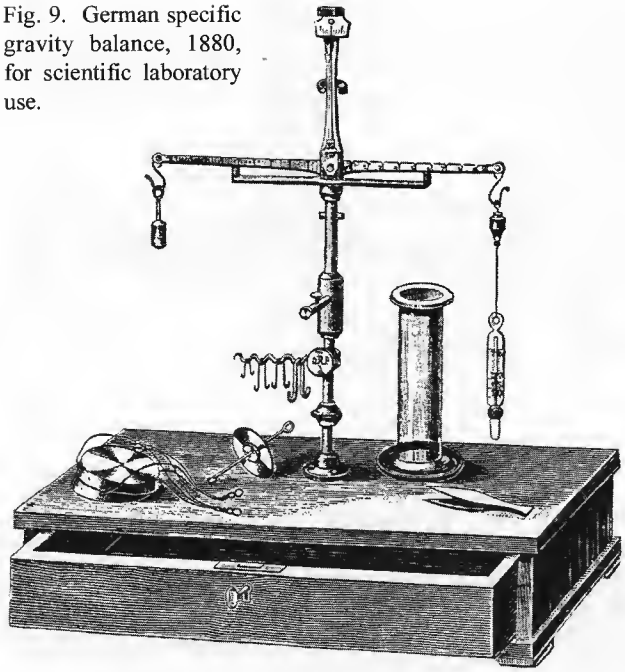


Fig. 9. German specific gravity balance, 1880, for scientific laboratory use.



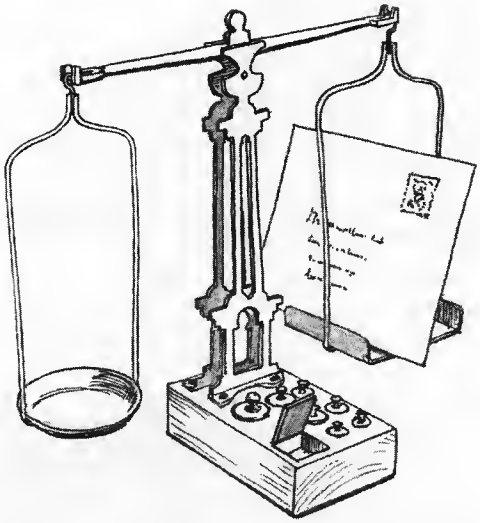


Fig. 10. ⋏⋏ French postal scale with horned ends, c.1850-1900. Weights of units for each postal rate. The lidded locker held stamps.

Fig. 11. ➢➢ English coin scale c.1775. The rectangle of brass immediately below the centre of the beam is a brake. When depressed with a finger, the beam is free to rock.

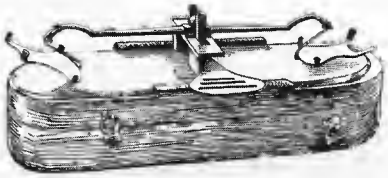


Fig. 12. ⋎⋎ French tobacco scale, patented 1850. Bifurcated (split) beam. The load was only slightly below the beam, so was not very stable.

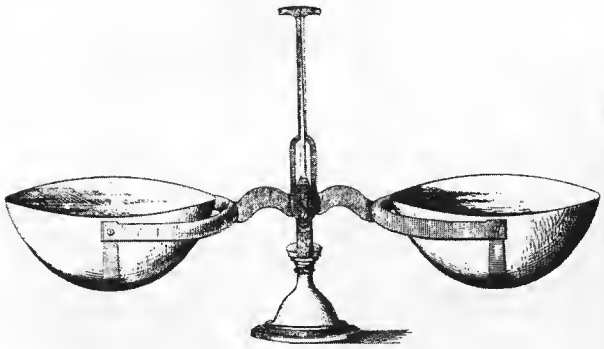


Fig. 13. ⋎⋎ American Mint scale, c.1850. Made to impress the customers as well as provide accurate weighings for 50 years. The beam is shown raised up from the arrestment arms (that look like candlesticks) ready to weigh.

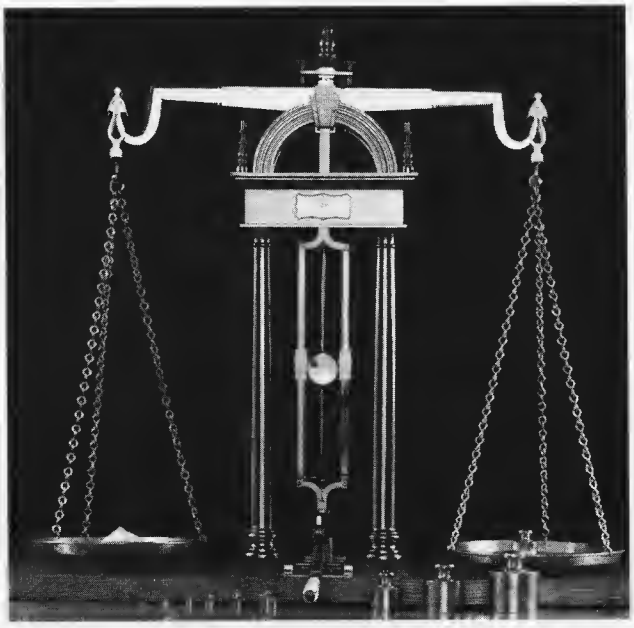


Fig. 14. ≺≺ American portable button balance with 5ins (126mm) beam for assaying a button of gold. Made 1905 with agate bearings. Not used in Europe.

Notes & References (continued from page 2570)

1. Biggs, N, "English Coin Weights," *Equilibrium*, 1060-1066.
2. Biggs, N, "English Coin Weights," *Equilibrium,* 1060.
3. Crawforth, M A, *Equilibrium*, 627.
4. Clifton, G, *Directory of British Scientific Instrument Makers 1550-1851*, Zwemmer & the National Maritime Museum, 1995, p 227.
5. Crawforth, M A, *Weighing Coins, English folding gold balances of the 18th and 19th century,* London, 1979, page 57. Obtainable from the editor.
6. Withers, P & B, *British Coin-Weights, a corpus of the Coin-Weights made for use in England, Scotland and ireland*, Llanfyllin, 1993.
7. Crawforth-Hitchins, D F, personal communication.
8. Editor - only one John G Smith, of 144 East Street, Walworth, London, SE, working in 1898, has been recorded, and he is listed in Trade Directories merely as a "Scale and Weight maker", with no reference to any particular type of scale.

Author's Biography

Serge Camilleri is multi-cultural; born in Alexandria, Egypt, of a Maltese father and Italian mother, he went to a French school, graduated in Zurich and was a Swiss actuary until his retirement. As a collector of coins he was soon attracted by the ingenuity of folding gold balances, and he concentrated on finding variations. He had the privilege and luck to get acquainted with Michael Crawforth, the author of his most-used book.

Review

Byzantine Weights, an Introduction, by Simon Bendall, published by the Lennox Gallery, London, 1996, ISBN 0 9528647 0 3. 68 pages 6 x 8¼ins. One black and white photograph of a set of scales and weights, plus 207 drawings or photographs of weights, plus 84 drawings of monograms found on glass weights. Available from Galata Press, Old White Lion, Market Street, Llanfyllin, Powys, SY22 5BX at £12.00 plus packing and postage, or from Harlan J Berk Ltd, 31 North Clark St, Chicago, IL 60602, USA.

Fig. 1. AA Commercial bronze weight for one pound. Two Imperial figures wearing military dress, each holding a shield and spear, tree to the right and leopard in bottom right field. The first symbol represents 'pound' and the second 'one'. The faces, heads and legs of the emperors, as well as the leopard's head and the denomination are inlaid in silver. The date is uncertain, as the emperors cannot be identified, (two emperors ruled together many times).

The reviewer knew nothing about Byzantine weights, and was delighted to find this introduction, written by an expert in Byzantine coinage. Basically it answers the usual questions; where, when, how, why and what. It is densely packed with information, and is easy to use. The introduction has sections on the weight system, dating, the issuing authorities, titles, centres and methods of production and values. The catalogue (drawn from many identified sources) has sections on struck coin weights, from the fourth to fifth

centuries and then from the late tenth to the early twelfth centuries, spherical commercial weights, octagonal commercial weights, octagonal coin weights, square commercial weights, square coin weights, circular commercial weights, circular coin weights, Western square weights, Western round weights, square weights without denominations, some unusual weights and glass weights. The book finishes with appendices of the Eparchs and Prefects of Constantinople, Rome and Egypt.

Fig. 2. AA Commercial weights for one pound (on the right) and for 6 ounces (half a pound), made of bronxe inlaid with silver. Probably made before the 6th century, at which time the symbol for ounce was changed from the fish-like shape to G. Courtesy Christies South Kensington, 13. 12. 1996.

The reviewer would have preferred that commercial weights had been dealt with in one part of the catalogue, and coin weights dealt with in a second part, but the author preferred to think about the silhouette as a defining characteristic, so big and little weights are mixed up. Nearly all the weights are shown full size, which reduces the confusion, but considerable cross-checking of units and mass was necessary.

Bendall is admirably cautious in his definition of a Byzantine pound, and discusses the ancestry of the system and the various conclusions of five authorities. It was wonderful to find a system where the same commercial pound was divided into twelve to give commercial ounces, and into 72 to give nomismata (coin units). How sensible! Why couldn't the British be that logical?

The author is equally cautious about attributing dates, because historically Byzantine weights were assumed to have been made between the sixth and seventh centuries, and the normal method of dating by archaeological stratification has been ignored by archaeologists eager to get below the Byzantine levels to the classical levels! Bendall starts with the first official coin weights struck in 363 AD. (see Contemporary Comment, page 2588) and considers that all known types were being made by 650-690 AD.

Fig. 3. AA Weight for 72 nomismata, weighing one pound.
Translation: *In the time of Zemarchus, gloriossus, Eparch of [new] Rome, ex-consul, 72 nomismata.*
In the centre is the bust of Zemarchus in consular robes, holding a mappa [cloth] and a sceptre topped by an imperial bust. [New Rome was Constantinople. Zemarchus ruled as Eparch in 562 and again in 565 AD.]

Bendall writes much about the officials whose busts and monograms help in dating, but he is remiss in not giving the beginner a rough sketch of the history of Byzantium. The reviewer had to go to other books to grasp the cultural background and the influences that affected the Byzantine Empire. Why had Byzantine weights turned up in Oxfordshire? Why were there weights relating to Carthage in Tunisia? It was the other books that explained the tenacity of the Roman culture that was maintained in Constantinople (later named Byzantium) and that the city had a huge trade with the Far East, the Mediterranean and round to Britain. Where there was trade, there were weights, one assumes. And thinking about ignorance, the author forgets that

many of his readers will not understand words like mappa, conob, nimbate, chlamys, caduceus, modius and tetarteron. His editor should point out the need for esoteric words to have translations or explanations.

Fig. 4. ⮝⮝ Weight for a gold semis [half solidus], made during the reign of Marcian, 450-475 AD. The obverse shows the monogram of Marcian, ruler of Constantinople. The reverse shows Moneta standing, with a star to her right and with CONOB below. Bendall does not translate Conob.

It was fascinating to discover that "the emperors in 378-392 instructed Praetorian Prefects to ensure that official measures and weights should be kept in each post-station (mansio) and city to enable tax-payers to know that they were paying the correct amount.

"In 545 Justinian I (527-565) issued a law allowing the tax-payers permission to receive from the Prefects weights and measures for commodities and from the Comes Sacrarum Largitionum weights for gold, silver and other metals. These weights were to be kept in the most holy church of each city. For Italy, Justinian instructed commodities or coins to be traded in the measures and weights he had delivered into the presence of the most Blessed Pope or of the Most Distinguished Senate. This role of the Church in matters of weights and measures also existed in the East where, for example, John the Almsgiver, on his consecration as Patriach of Alexandria in 610, promulgated a public edict forbidding the use of weights, measures and balances not conforming to the standard."

The coin weights came in strange sub-divisions, 72, 36, 18, 30, 26, 24, 20, 18, 17, 15, 12, 9, 8, 6, 5, 4, 3, 2, and 1 nomismata. Was the weight for one coin? A group of coins?

As with so many weights, the centres and methods of production have to be deduced from internal evidence. Bendall is not seriously interested in this aspect, and restricts himself to descriptions. These descriptions got the reviewer excited. These weights are superb at their best, beautiful little works of art in their own right, and even the common ones are intriguing, with primitive graffito sketches or bold monograms on them. The more one studies the pictures and reads the thorough captions, the more enticing are the designs. Personally, the ones inlaid with silver or copper are the most attractive, but other people might like the coin-like ones the best, with their row of emperors (ruling together) or with the goddess Moneta standing with her scales.

That such a little book could open so many windows is wonderful. The catalogue can be used to identify the Byzantine examples that have come up in auction. That the whole can be bought for such an insignificant price is useful. That the reviewer read it through twice with growing delight, and had no inclination to get irritated is amazing! This book is recommended! D F C-H

Fig. 5. ➢➢ Circular commercial weight for three ounces. The flans of both circular commercial and coin weights were sometimes turned on a lathe. Why was the good workmanship of the turner passed over to such a poor workman for engraving? This example was crudely engraved, but some were stippled, and thus very lightly marked. This example has a plain perimeter, but some examples have writing round the edge.

Mystery Scale

BY G A WEHMAN

Three examples of this small brass beam scale[1] have turned up within the last two years. The beams are stamped Fairbanks. The beam balances exactly on zero when the box is attached, so presumably the beam and the box were made to be used together. There is no mark on the beam or the box to indicate that the set had to be kept together (as is needed for grain scales). The scale gives us no clues as to its function.

The load must be something dry as the pan/box is not sealed. The pan is roughly 2 pints' capacity and the load has to fit into the box so cannot be longer than 8 inches. One person identified it as a cranberry scale, which sounds reasonable. A pound of cranberries would fit nicely into the box. Others have suggested plums or prunes. The seller of the third example said he bought it at a squab farm, but squabs are too heavy to have been weighed in it..

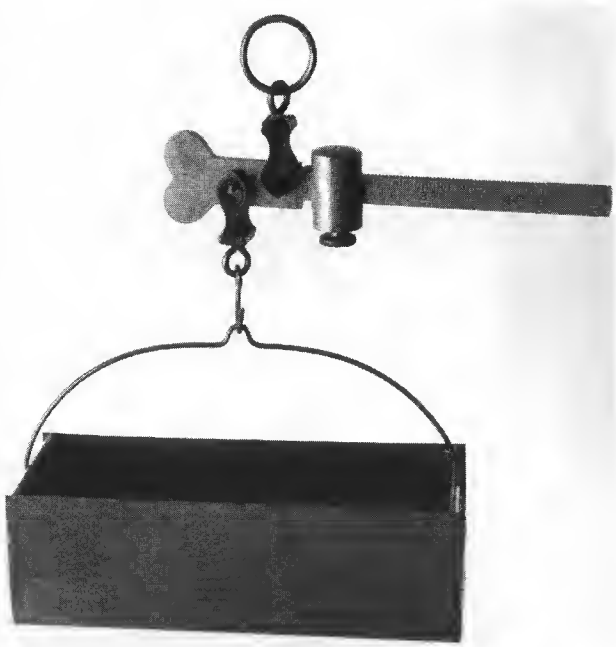


Fig. 1. ⋏⋏ Fairbanks hand-held beam with folding brass box. Beam 8ins. (200mm) long, graduated 0 - 16oz. The beam and the poise are a good golden-colored brass. The shears and the hanger are black iron.

Photo courtesy P Wehman

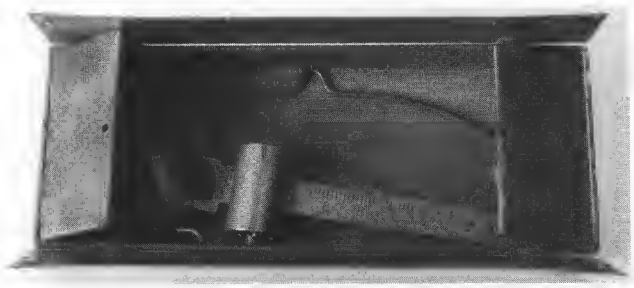


Fig. 2. ≺≺ Fairbanks folding box is made of sheet brass, 8 x 3 x 1 inch (200 x 76 x 25mm). The brass is very thin and strengthened by folding the edges over where they are not bent or attached to another edge. The top flaps just join in the center. The box is just large enough to hold the beam and the wire hanger.

Photo courtesy P Wehman

Looking at the details of the shape, the "double petal" end is unusual, and has not been identified as a Fairbanks end. The poise with its flat set screw underneath is very like the screw on Fairbanks bottle testing scale, as shown in their catalogues of 1919 and 1927.

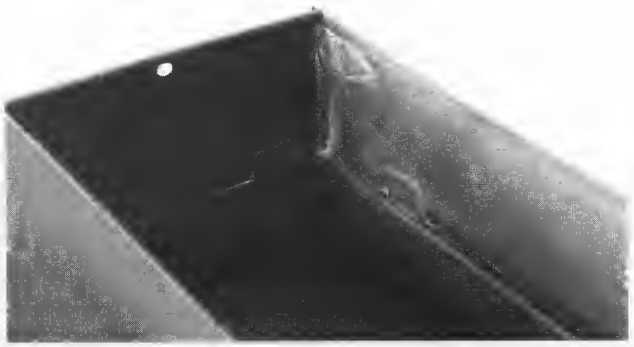


Fig. 3. ➢➢ Fairbanks. The box is neatly made with the top edge of the sheet turned over to give a strong smooth edge. The clip on each end of the top flap is designed to mesh with the end flaps so that the pressure of the springy hanger pulls the end flaps ever more firmly into the clips, and thus prevents the box from folding shut inadvertently. The small hinges on the ends and sides are well-made and help to keep the side joints very close. The assembled box is 8 x 3 x 2½ inches (200 x 76 x 50mm), giving a total volume of 60 cubic inches.

Photo courtesy P Wehman

Two examples made by Howe of a nearly identical steelyard have appeared on the market recently. The entire mechanism is very slightly larger and heavier than the Fairbanks, and the pan is in the form of a collapsible bucket similar to the cups carried by campers and hikers. These beams display a patent number, which normally would lead straight to the designer/maker and the function, but somebody at the factory had that Monday Morning Problem and stamped on a number that is for a horseshoe-nail patent!

This model has been described as a tea scale, again suggesting that the scale was for weighing a crop. Tea seems an unlikely load, as tea was always sold in a store, having been through a highly

Fig. 4. ⮝⮝ Fairbanks poise has a screw for fixing it to the beam, so that a pre-determined amount can be weighed repeatedly.
Photo courtesy P Wehman

Fig. 5. ⮜⮜ Howe also used good golden-colored brass with black iron hangers, but the beam is slightly larger, 8¾ins (220mm) long.
Photo courtesy J Berning

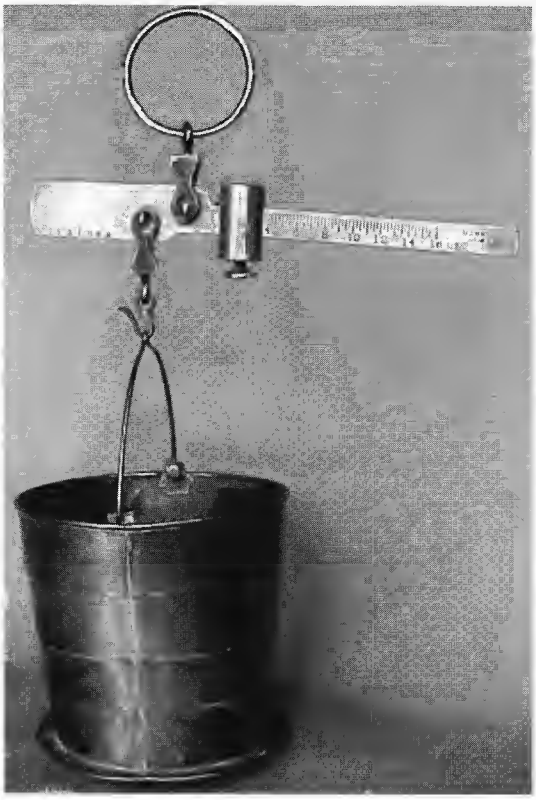


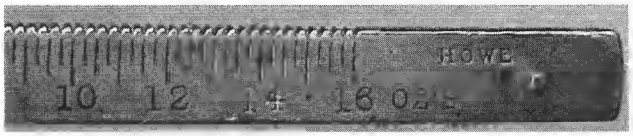
Fig. 6. ⮞⮞ Howe number 1131248.
Photo courtesy J Berning

Fig. 7. ➢➢ Howe also saw the necessity for a compact container, but used a collapsible bucket 5ins (123mm) diameter and only 1⅝ins (35mm) tall when shut down.

Photo courtesy J Berning

Fig. 8. ⋎⋎ Howe also used a 16oz capacity beam graduated by ¼oz, and put a pip at the end of the beam to prevent the poise from sliding off the beam.

Photo courtesy J Berning



industrialized process, and having a high retail value. These scales were carried about, and the buyer wanted a compact scale.

Such neat little beams are rare in the United States. We are very eager to identify their use and give them an approximate date. We have questioned F A Norden of the Fairbanks Museum, and ISASC members Bill Doniger, Jerry Katz, Dale Goldman and Bob Jibbens, but no one has any further information. Several people agree that since they are hanging or hand-held they were probably meant for repetitive weighing by people going from place to place selling, testing, (or perhaps using) specific quantities of something at each stop.

F A Norden of Fairbanks commented that the company manufactured so many speciality scales in the early 1900s that it would be very hard to list them all. A search of the Fairbanks catalogues of 1859, 1862, 1880, 1882, 1891, 1906, 1919 and 1927, and additionally, the Howe catalogues of 1883, 1896, 1899 and 1902 has been fruitless.

Bob Jibbens suggests that we take a look at Chick-Pea Scales, EQM 420-421.[2] These tiny scales were used to assess the quality of the crop by count. However many peas balanced the poise, gave the user a very good idea of whether his crop was suitable for human consumption (40 peas to the onza), seed for next year (50 peas to the onza) or for use as animal fodder (70 peas to the onza). The fixed poise means that the function of the scale was different from the moving poise of the Fairbanks and the Howe beams, but the use of a compact beam stored inside its container does reinforce the idea that a crop was involved. Can any reader help?

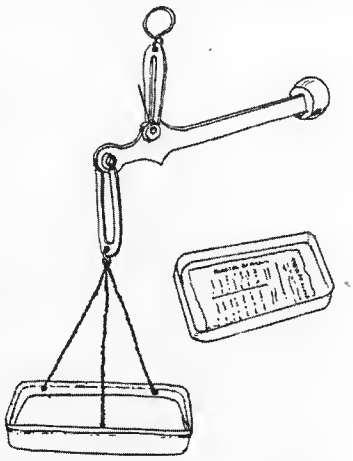


Fig. 9. ⋏⋏ Castell chick-pea scale 2ins (50mm) long, made c.1930. As with most chick-pea scales, the beam is stored in the pan/box.

Drawing by S Berastegui

Notes & References

1. Europeans call it a steelyard.
2. Berastegui, S, "Chick-Pea Scales," *Equilibrium*, 420-421.

Acknowledgements

With particular thanks to Jan and Bill Berning, Harley Crawford, George Anna and Phil Wehman.

H M Weaver Improved

FROM THE PATENT

Use of the term "Unique," meaning the only one of its kind in existence, is almost never justified. But the "Most Unusual" postal scale described by Ted Stein[1] EQM, 2511-2513 may be the exception.

The second patent of 27 July 1875, number 166,046, proved to be most interesting. See Fig. 1. The screw mentioned in Note 1 was removed, and a new longer screw inserted that pressed against a bifurcated extension to the legs. See Fig. 2. When adjusted it caused the legs to tip the left-hand side of the scale up or down relative to the right-hand side of the scale, levelling the scale when a container was used so that the pointer again was set at zero. See Fig. 3. This is the same method of zeroing that PJ Maul used for all his numerous pendulum scale designs twenty years later. See EQM, 1627-1634 and 1649-1661.

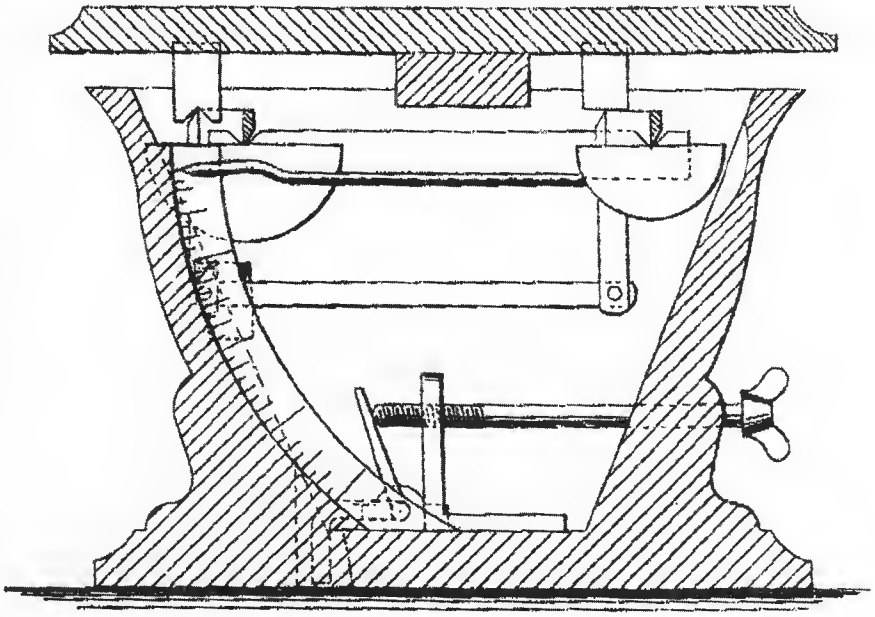


Fig. 1. ⩓ Weaver's patent of 27 July 1875, number 166046.

Concerned that his first version oscillated for too long, Henry Weaver minimized the problem in his second version by dividing the poise into two smaller semicircular poises, one with a bigger radius than the other. See Fig. 4. This meant that the larger poise had a slower swing than the smaller poise, but, being on the same linkage, the swings retarded each other and the linkage quickly stopped moving.

The capacity of the first version was limited but the second version could weigh a much greater range of loads (when the graduated arc was replaced). The capacity of a pendulum scale is normally altered by using a heavier poise, or by moving the poise away from or towards the

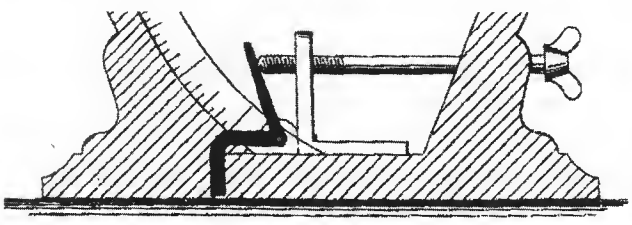


Fig. 2. ⩓ Showing the adjustable leg that could tip the scale for accuracy and for taring.

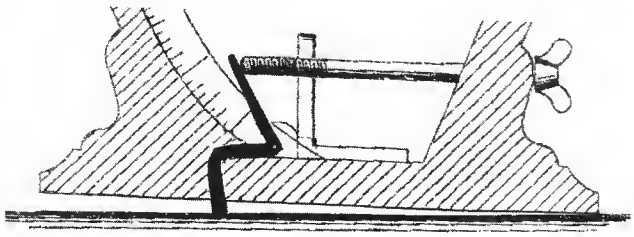


Fig. 3. ⩓ Showing the screw moving the leg to the left and down to raise the scale.

fulcrum. Weaver used both methods, by having a little cylinder on a rod screwed into the underneath of the poise. The cylinder could be raised or lowered, nearer or further from the knife-edges, so could be adjusted to suit any pan or plate, or to alter the capacity of the scale. Two cylinders could be applied if desired, one each end of the semi-circular poise (behind the cylinder showing, as viewed in Fig. 4).

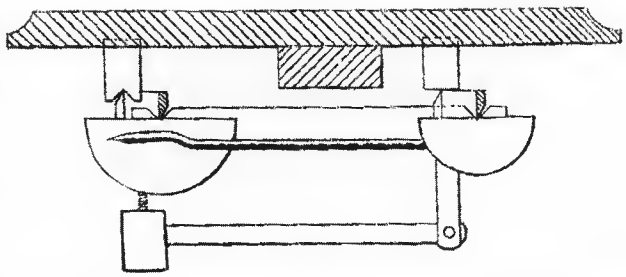


Fig. 4. ⩓⩓ Showing the two, different-sized poises with the left-hand poise having a cylinder-shaped poise screwed into its bottom.

The patent shows that Weaver was truly innovative. It is amazing that only one example of his work is known.

Notes & References

1. There is an error in Fig. 4 p 2513. The screw should have been loosened and screwed out of the casing, to permit the graduated arc to drop and thus put the pointer at zero when a container was added. The editor thanks Ritzo Holtman for this correction.

A Lion in Venice

BY G WILSON

Recently I had the privilege of sharing with our members my "find," an exquisitely-made set of nesting cup weights, and my adventures --as a collector of scales, not weights--in answering my first question: Whence cometh this beautiful little set of weights? [1]

With the help of Gary Batz and both EQM editors, I was able to conclude that the set was made in Nuremberg, but during a period when Nuremberg was making such weights for jurisdictions all over Europe. The stamp on the lid, a chalice, was the mark of the Fleischman and Lenz families, who had been active from the 1600s to the 1800s and using that stamp from 1725. By weight, the cups seemed suited to weigh the marca of Venice, which was a city-state at that time, but I still have to find out what the Venetians called the 16 units into which the marca was divided.[2]

However, the verification stamp, though worn badly, appeared to consist primarily of a pair of wings viewed from the front, as perhaps an eagle. If the inspector was Venetian, his stamp would most likely contain the winged lion of St. Mark. If this stamp was the winged lion it would have to be a frontal view to have any bilateral symmetry. I had never seen any frontal view of the lion of St. Mark and could not find one. I was also puzzled by the prominence given to BP's initials.

Fig. 1. ⩓⩓ Venetian silver Ducat of Marcantonio Giustinian, 1684-1688, showing the conventional side-view of the lion.

See Figs. 1 & 2 for the more common representations of St. Mark's lion in side view.[3]

Fig. 2. ⩓⩓ Venetian Scudo of 1795 showing a nice variation of a seated lion. His halo and his book show clearly.

Gradually the pieces fell into place. Gerard Houben mentioned that such a depiction of the Venetian lion is known from several coins. Our Editor located the exact adjuster's stamp, complete with the initials BP, in a 1982 Italian publication by F I Mazza. Although Mazza provides no text, Guido Zavattoni assured us that the photo is the winged lion of San Marco. It seemed pretty conclusive, but there was still an element of doubt.

Fig. 3. ⅄⅄ Venetian Scudo of 7 lire, minted during the period when Leonardo Dona was Doge, 1606-1612. The lion is not as distinct as the one in Fig. 4.

In that article I had the wisdom to note, as a closure, the possibility of gaining additional knowledge about our little treasures from our own members when they became aware of our puzzlements.

The member to my rescue was again Gary Batz. He has found and purchased a fabulous book by the Ghent printer, Joos Lambrecht who had the emperor's privilege and monopoly to issue books about the values of coins circulating in the Spanish Netherlands in 1552. The book has 192 pages and, in English translation, is titled *The Unpermitted Gold and Silver Coins of divers Kingdoms, Duchies, Counties, Manorial Houses, Lands and Cities.* In the Spanish Netherlands these coins were to be valued only as bullion. Deep within this precious book were the images of four coins identified as Venetian, one of which has on its obverse, SANCTVS MARCVS and a frontal view of the winged lion of St. Mark, while the front displays the doge Nicolaus Tronus, see Fig. 4.[4]

Fig. 4. ⅄⅄ This Venetian coin was made during the period when Nicolò Tron was Doge, 1471-1473. Here at last was the lion clearly shown full face.

"The matter of the prominence given the initials of the adjuster over the symbol of his country?" wrote Gary. "Quite simple. The country was secondary. The verifier came first. That way any one giving the weights a glance could recognize the imprint of the big-shot scale and weights verifier whom every merchant in town feared. Suppose the initials were tiny and grungy. That way they could be easily forged and someone looking at the lion would say, 'The weights have been done.' " Thank you, Gary! You made my day!

Notes & References

1. Wilson, G, "Discovery." *Equilibrium* 2520-2524
2. Forien de Rochesnard, J, *Dictionaire Ponderal*, Paris, 1967. He gives the Venetian system as 1 marca = 32 quarti = 64 ottavi = 192 denari = 1152 carati = 4608 grani. The words mean quarters (of an once), eighths, pennies, carats and grains.
3. Ede, J, *Gold & Silver Coins*, London, 1808, plate 10 and plate 12.
4. Lambrecht, J, *The Unpermitted Gold and Silver Coins of divers Kingdoms, Duchies, Counties, Manorial Houses, Lands, and Cities*, Ghent, 1552.

Contemporary Comment, 363 A.D.

Quoted in *Byzantine Weights* by S Bendall. See pages 2573-2575.

EMPEROR JULIAN AUGUSTUS TO MAMERTINUS, PRAETORIAN PREFECT
The buying and selling of solidi [nomismata] is impeded if anyone clips down or diminishes or - to use the word proper to such avarice - nibbles them away, for some persons refuse them as light or inadequate. It therefore pleases Us to appoint a zygostates [weigher] as the Greek word terms him, in each city, who on account of his faithfulness and industry will neither deceive nor be deceived, so that if a dispute shall have arisen between a seller and a buyer of solidi, it may be settled according to his judgement and reliability.

Given 23 April at Salona [near Split on the Adriatic] in the Consulships of Julian Augustus (for the fourth time) and Sallustius.

Notes & Queries

N & Q 145	From B BRASS

I was told that my Young & Son person scale, a steelyard next to a leather-covered seat, was a jockey scale. See EQM, page 18. Is this correct?

Reply	from the Editor

We got our Young & Son person scale from a doctor's surgery, where it had stood since 1884, so for many years we called ours a person scale.

But I was told recently that the Paris race-course used a Young & Son person scale to weigh their jockeys. So, yes, you are correct.

Marriott made spring balances with a seat slung below to weigh jockeys. I have seen Salter's version on race-courses recently.

The *Illustrated London News* of September 18, 1875 shows a drawing of the interior of a room at Doncaster race-course. I have removed from the drawing the crowd, the Clerk of the Course, the horse's owner, and two jockeys, to give a clear view of a strong swan-neck beam being used (Fig. 1).

The *Beginner's Guide*, page VII, fig. 7 shows the Avery beam from the 1880 catalogue, costing between £5..5s and £9, according to quality. The Avery equivalent of the Young & Son cost £10..10s.

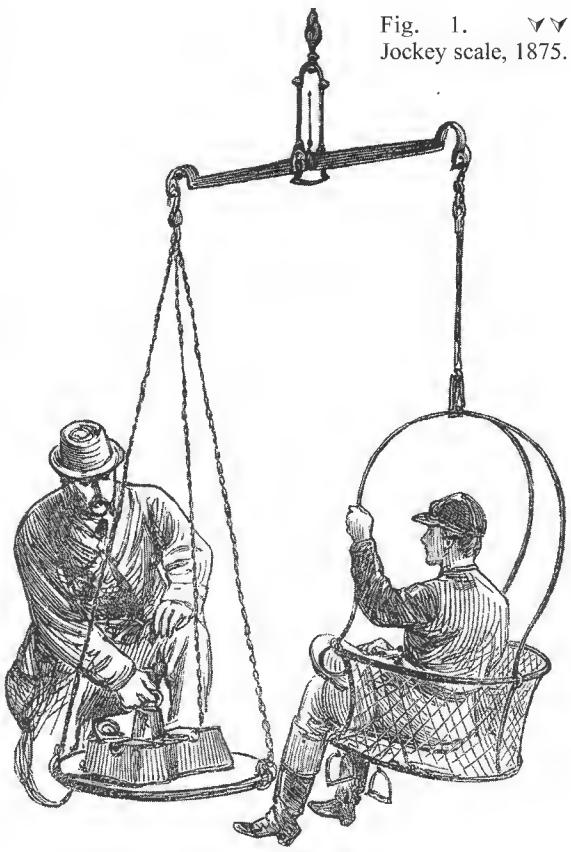


Fig. 1. Jockey scale, 1875.

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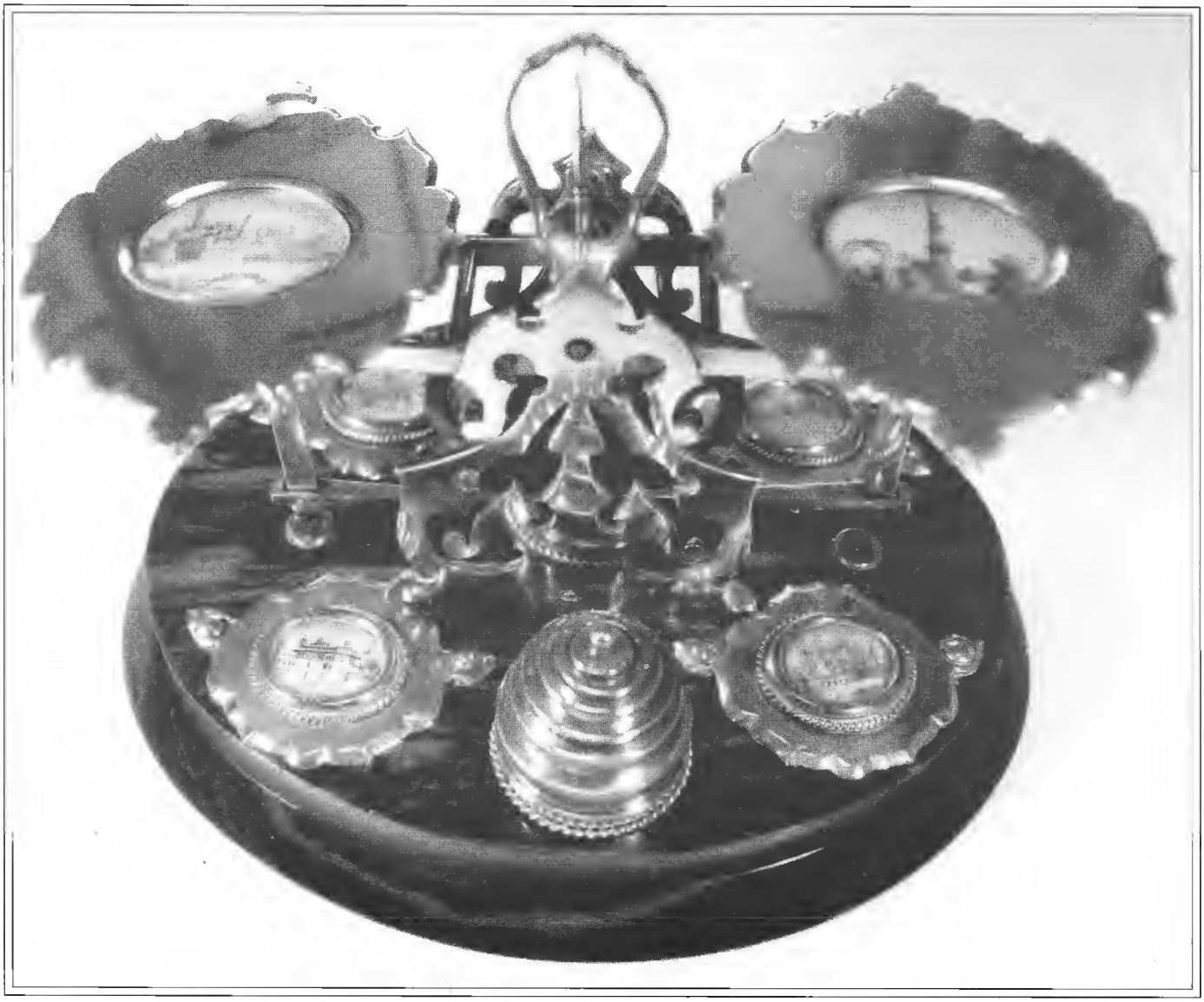

Cover Picture

The Beginners' Guide this quarter concerns top-pan equal-arm scales, a category that includes roberval scales. English makers of postal scales embraced this style whole-heartedly, making eye-catching, elaborate examples to enhance the gentleman's desk. Sampson Mordan of London particularly used this high style, producing hundreds of different designs, using choice materials, and incorporating many expensive vignettes.

This example has a coramandel wood base with gilded brass fittings. Mordan's characteristic rope edging surrounds the cartouches and the weight cup. The largest weight is for 8oz, coming down to a knobbed 1/4oz. The cartouches are called Limoges-ware, although we have no evidence that they were made in Limoges, France. Certainly they are exquisite porcelain plaques, made specifically for the Britsh market.

The British were very proud of their Empire, particularly the Indian part, and loved to have pictures of typical Indian scenes in their houses. This scale has six different scenes of Madras, Bombay, Calcutta and Agra, finely painted like little miniatures.

R AXELROOD COLLECTION

ISASC
INTERNATIONAL SOCIETY OF ANTIQUE SCALE COLLECTORS

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Sartorius Again

BY L HOLLAND

As soon as I opened EQM, I was spellbound by the article on that utterly incredible Sartorius balance. What a breath-taking sight it must have been (an image comes to mind of Cinderella's dazzling coach-and-four)! What a thrill to be able to touch, handle, operate such a thing! Envy is supposed to be a sin --- well, I must confess I envy you most dreadfully.....

I used Sartorius balances for forty years during my work at the Hadera Paper Mill, and had plenty of opportunity to learn to admire the marvellous ingenuity and precision with which they were made. When the mechanical balances were replaced by load-cell balances and consigned to the rubbish-heap, I was lucky enough to be able to salvage three different models and get them back into working order (two of them are still doing yeoman service); one of them was a Selecta, (see page 2597,) an equal-arm balance with a single pan and lever-operated weights on a frame hung from the other arm --- in that respect, it resembled the one you describe (somewhat as a Morris Minor resembles a Rolls-Royce). At present, I use the latest "rescuee", a substitution balance, one of the very last mechanical models built by Sartorius.

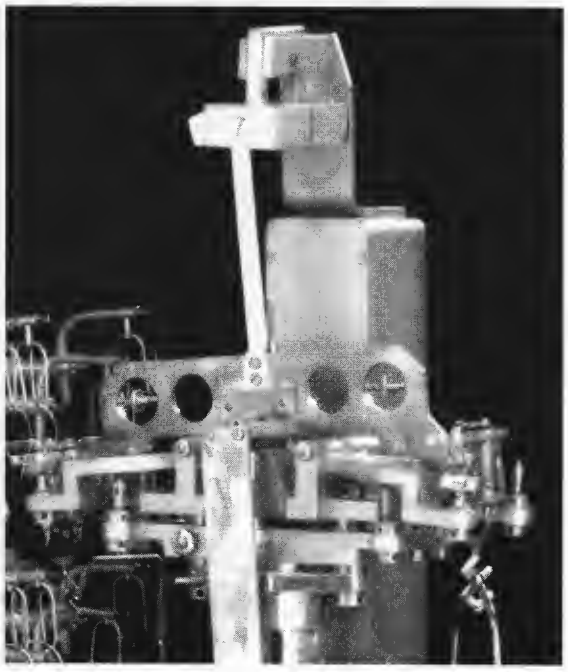


Fig. 1. The two-centre radial arrestment photographed in its released position, and with some weights causing the beam to drop to the left. The magnetic damping rises from the fulcrum to the top of the picture.

One of the photos accompanying your description of that fabulous "dream-balance" shows a close-up of the "two-centre radial arrestment". Did you know that this design for the arrestment mechanism was invented by D I Mendeleyeff, the great Russian chemist of "Periodic Table" fame? To function properly, it has to be made to extremely precise specifications --- so much so, that the only commercial manufacturer of balances ever to adopt the design was apparently Sartorius. I don't remember where I got that information from -- probably from Hans Jenemann, with whom I was lucky enough to correspond for several years, and who sent me offprints of many of his writings.

Another unusual feature of the balance you describe is the magnetic damping system. Unusual, in the sense that Sartorius invariably used pneumatic damping on his mechanical balances (you can recognize a Sartorius balance a mile away, by the damping cylinders) --- except, of course, that pneumatic damping won't work if you are weighing in vacuo; so an exception had to be made.

I find the whole business of weighing in a vacuum a bit puzzling, actually; why would one want to do it? Wouldn't the weights need to be re-calibrated for weighing in vacuo, since they, and the entire balance, must (presumably) have been originally calibrated in air at atmospheric pressure? Did the maker perhaps supply correction factors for this contingency? Or were the necessary

corrections perhaps so small as to be less than the sensitivity of the instrument (which, by the way, you didn't mention --- was it 0,1mg, as for a common Sartorius laboratory balance, or something else?). By my rough estimation, that assemblage of weights shown in your photo would displace several mg of air---- enough to introduce significant inaccuracies.

I can make much more sense of the idea of protecting the balance against corrosive vapours in the laboratory; one could fill the dome with an inert gas such as nitrogen, and maintain just enough positive pressure inside to keep any corrosive vapours out. Even in my laboratory at the paper mill, which was relatively free of corrosive vapours as laboratories go, the metal parts of the balances tended to corrode. It would be very much worse in, say, a laboratory doing mineralogical analysis, where samples of ores were being roasted in the way you describe, and giving off all sorts of fumes. Anyway, thank you for sharing such a thrilling experience with the readers of EQM. I'd love to know what happens at the auction and who (if anybody) gets to buy it.

Why Vacuum Weighing?

FROM T ALLGEIER

There are basically two reasons:
As stated correctly by Lionel Holland, there are errors when weighing in air, as soon as goods and weights have different specific gravities. These are small for almost all purposes, but when you look at reference masses, like the national standards etc. these errors become important. So there was a move towards vacuum weighing for mass intercomparisons as soon as the technology became available. Alas, to no avail: Although the density errors were completely eliminated, the reference masses themselves became unstable: The constant alternation between air (storage) and vacuum (weighing) caused absorption and adsorption effects to take place on the weight surface, making them heavier or lighter as the case might be. Result: Even today, all mass intercomparisons are done in air. Air buoyancy errors (the correct term) are taken into account purely by calculation.

The other reason is science. There are some processes, mainly chemical, that prescribe reduced pressures, vacuum or atmospheres different to air for them to take place. If weighing is involved in those, the balance has to cater for it. Hence the Vacua.

FUNCTIONS FOR WHICH THE VACUA WAS DESIGNED ,
according to the Sartorius 1952 catalogue.
[Editor:- adsorbent = condensation of gases on surfaces of solids]

1. Measurement of the rate of chemical reactions, which run under weights-alteration at any temperatures by use of a high frequency furnace. [Thermo-gravimetric analysis, or TGA]

2. Measurement of the evaporation rates and the steam pressure according to the Kundsen method, Ruff Ruff-Fischer and the carrying method.

3. Recording of water vapour and other gases as well as organic vapours as a function of printing and temperature by insulating layers, such as impregnated papers, textile tissue, plastics.

4. Recording of vapours or gases from paper and other cellulose products, from textile fibres, half-synthetic and fully-synthetic fibres, and from plastic samples, in particular plastic foils.

5. Check and quantitative determination of the permeability of paper and foils of all kinds for gases and vapours, using the measuring method: A closed bag of the foil concerned contains a suitable adsorbent, which adsorbs through diffused gases and vapours. Measurement of the entire sample as a function of external pressure and temperature constantly by appropriate weight-increments of the bag.

6. Delivery of water vapour and other gases during vacuum and freeze-drying processes of sensitive colouring materials, food and pharmaceuticals.

7. Absorptive capacity and absorption velocity of gases and vapours in activated charcoal, silica-gel and other technical absorbents.

8. Gas analyses by weight-related pursuit of the absorption of a component; Density determination in inert gas, the same way as with a Mohr balance.

Some of the processes are listed in the Sartorius catalogue. One simple example is drying of substances, or rather measurement of moisture content. Weigh a sample under atmospheric conditions. Start pumping, and weigh as the vacuum causes it to dry. At some point, when all moisture is gone, the weight stays virtually constant. The difference to the initial value is how much water was present before drying.

Balances in general do not have provision for buoyancy correction as such, much rather do they work on a convention of an arbitrarily-selected specific gravity of the weights. In simple terms, the buoyancy errors of an equal-arm balance are zero if the goods have a density of 8000 kg per cubic metre. In any other cases, there will always be errors.

The story changes gradually as you reduce the pressure, in other words, the contribution is proportional to air density, and almost proportional to air pressure. In vacuum, it is zero. See above on mass comparison.

I am still convinced that no special adjustments were made to the weights of the Vacua, as we now know the balance was meant to be used for all sorts of different atmospheres, at different pressures. For which composition and pressure would one make adjustments?

NOTE FROM THE EDITOR: Dipl. Ing. J Barankewitz was kind enough to provide recently a list of the serial numbers of Sartorius' balances, with the dates of manufacture. This proves the gold-plated example was made in 1955.

Christie's South Kensington received bids below the reserve price, (but considerably higher than the team anticipated!) and the balance was withdrawn. Since then several people have expressed interest in buying it. Christie's hope to put the balance in their auction of 13 Dec, 2001.

Arresting the Vacua

BY B OLIVER

Mr. Holland raises several interesting points. Yes, we did get a little carried away and we did not make some of the basic facts clear. The particular balance we saw had a capacity of 100g, with full weight-loading down to 10mg, the last 10mg being on the optical scale readable to 0.01mg. There was also a higher-capacity version in the catalogues, carrying 200g, readable to 0.1mg.

Who invented radial arrestment, alias arc arrestment, alias circular arrestment? I too thought Mendeléef,[1] but wrongly. Jenemann has written widely but erroneously, to this effect; the point is that Mendeléef appears to be the first to *publish* on it, in 1875.[2]

Brauer,[3] writing in 1880, just a few years after the event, states that radial arrestment was devised by the Viennese academic engineer Friedrich Arzberger (1833-1905), later director of the Austrian Bureau of Standards. He had a great positive influence on the balance makers of Vienna, such as Rüprecht, Nemetz and Starke & Kammerer.[4] Whilst it seems that these makers took up the idea in a small way, and Stollnreuther too,[5] the first major manufacturer to use radial arrestment commercially was Florenz Sartorius in Göttingen, Hannover. Most, but not all, Sartorius analytical balances feature radial arrestment, right up to the end of mechanical balances in the 1970s.

When we look across the world to see which other makers used the concept, a clear pattern emerges. The big European makers used it to a greater or lesser extent (e.g. Bosch, Bunge, GPW, Hartner, Kern), whereas only one of the many American makers, Christian Becker,[6] took it up.

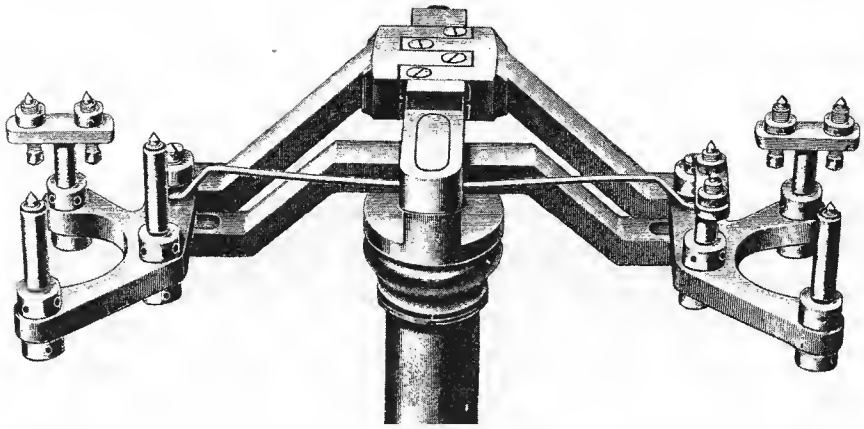


Fig. 1. ⩓⩓ Göttinger Präzisions-wagen-Fabrik [GPW] 1913 catalogue. *Mendeléjew's Circular Arrestment. Mendelejew was a Russian chemist and first designed an arrestment for analytical balances, where the left and right rocker arm carried the supports for beams and hangers and turn around a pin, whose centre line is situated exactly on the extension of fulcrum of the beam.*

We applied this circular arc arrestment for years, as did many companies here [Germany] and in foreign countries with success, and we made some improvements on our top models.

The supports for the beam and the pendants extend out over the points, on which the planes of the beam and the pendants are put. The supports are protected therefore from the effects of dust The arms for the supports are so strong that bending cannot occur while fully loaded.

The arrestment points move in the same circular arc as the swinging beam, and the arrestment points are all in line (only found on G. P. W.-Analysenwagen), and secure an accurate meeting.

The lower lever-arm U operates after both sides of the pillar-top are locked and possesses hardened inserts for the accommodation of the adjustment screws of the two support-arms.

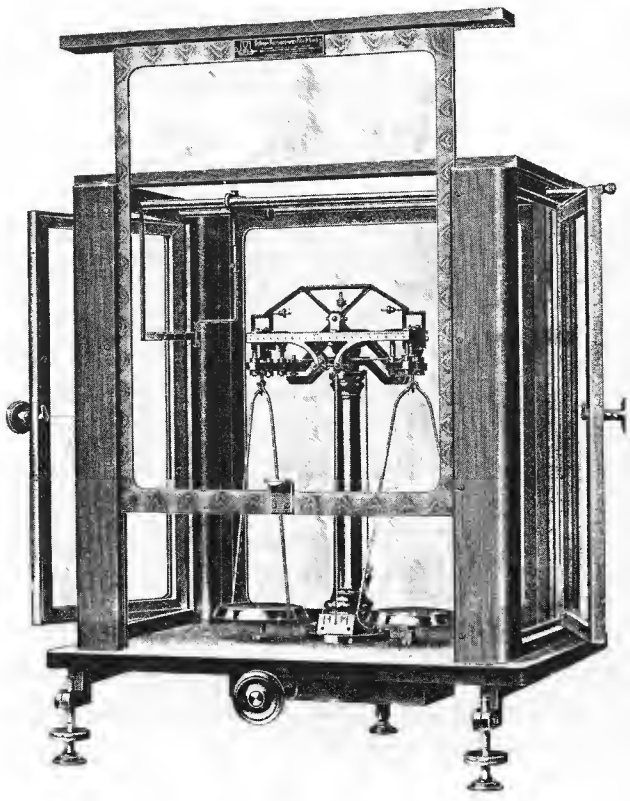
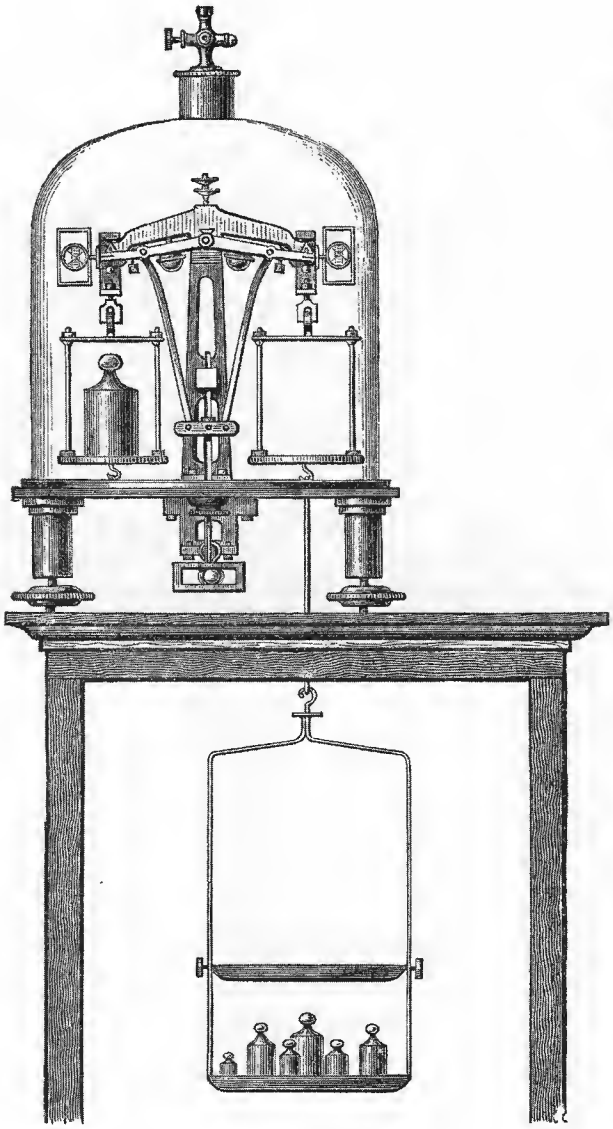


Fig. 2. ≺≺ Göttinger Präzisionswagen-Fabrik [GPW] 1913 catalogue. This balance was first shown at the Paris Exhibition of 17 Nov. 1900.

Analytical balance No. 3. Available with capacity of 100g, 200g or 500g. GPW Analysenwage Nr. 3. This balance is inserted in an elegant and solidly operated aluminium housing, with counter-balanced sliding front door, back-door and side-doors provided, and installed on black polished plate-glass. It has gilded bronze or Magnalium beam (light alloy), patented unstressed axle correction and improved compensation hangers, whose falling down is avoided by the beam construction. Bearings and planes of agate, pans platinum-plated. The hanger bases are laid out and by agate points are likewise locked with agate cells. In the same way the beam is stored, so that each harmful adhesion and wear of the points of contact are avoided. Sensitivity and fast oscillation, above all however the extraordinarily good consistency, in which the balance remains, are unsurpassed. Housing executed as with No. 2. Every other beam form can be selected. The balance is equipped with our proven circular arc arrestment.

And in Britain? Oertling used radial arrestment in only one design, a vacuum balance that occurs only in the 1909 catalogue: the *Mendeleef Vacuum*. See Fig. 3. It is clearly the later commercial version of the one that Ludwig Oertling made for the Standards Department in 1876 to a design by Mendeléef, and which is shown in Chisholm.[7] See Fig. 4. As stated, Mendeléef published his design in 1875, and an engraving is conveniently reproduced for us in a recent Jenemann publication.[8] The design is very similar to, but not exactly the same as, the Oertling-built



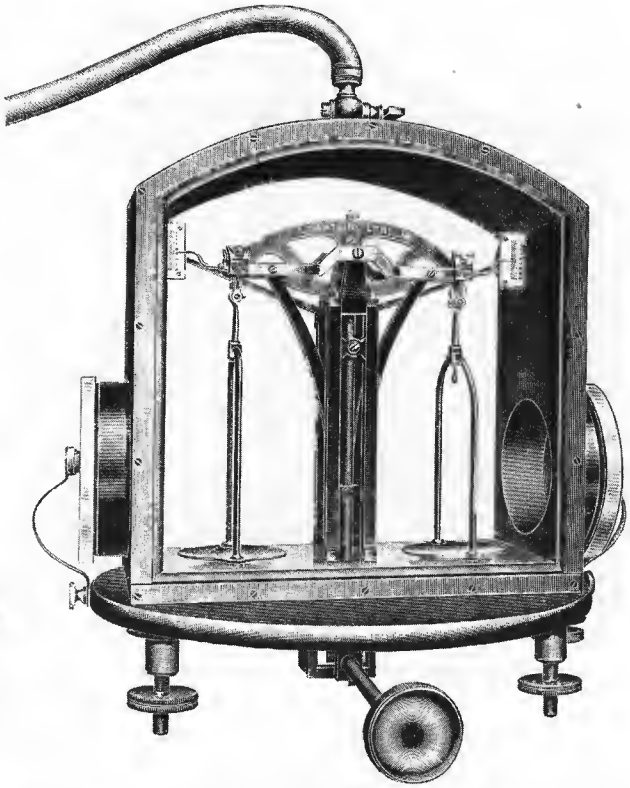


Fig. 4. ⩓⩓ L Oertling, London, 1909 catalogue. Physical Balance designed by Professor Mendeleef, as used by the Standards Department. Beam 4³/4ins (120mm) long, to carry one kilogramme in each pan and turn with 0.1 milligrams.

Fig. 3. ≺≺ Mendeleef Balance of 1876, built by L Oertling. Beam 4³/4 (120mm). One division is equivalent to 0.07 milligrams. With a kilogram in each pan, an additional weight of a milligram has been found to cause an observed difference of fifteen divisions of the scale [graduations]. Used by the Standards Department of the Board of Trade for the verification of Standard Weights. Shown in Chisholm,[7] 1877

one shown in Chisholm.[7] They look very much like two products of two different makers working to the same drawings. So, who made the "1875" one that Mendeléef himself used?

There is an 1898 paper by Mendeléef[9] on fundamental balance research, in which he specifically states that the favoured balances in his labs at the Russian Central Chamber of W & M, St. Petersburg, were constructed by the well-known balance makers of Vienna, Rüprecht and Nemetz.

My hypothesis is that Arzberger invented radial arrestment circa 1870 and either didn't publish it or "lost" it in an obscure journal. The concept was taken up by either or both of the local makers, Rüprecht and Nemetz. Mendeléef bought such a balance from one of them, and later ordered a vacuum balance of his own design, but featuring radial arrestment, from Vienna. Being pleased with the performance of his new balance, he later recommended our British Standards Department to have such a balance made here. Ludwig Oertling built one in 1876, almost an exact copy, and

later introduced a simpler development of the design into his catalogue range. Very few were made; I know of just one survivor.[10]

Meanwhile, following the Mendeléef publication placing the concept in the public domain, Sartorius took up the idea very enthusiastically, as did several others. But why? This is a complicated device; the conventional parallel-frame drop-action system is so much easier to make. Answer, because it is theoretically superior. In brief; a conventional drop-action arrestment has a purely vertical motion catching the end of a beam moving in an arc - there will be a tiny sideways motion upon contact. But it is the loaded sideways motions of knives across planes that causes

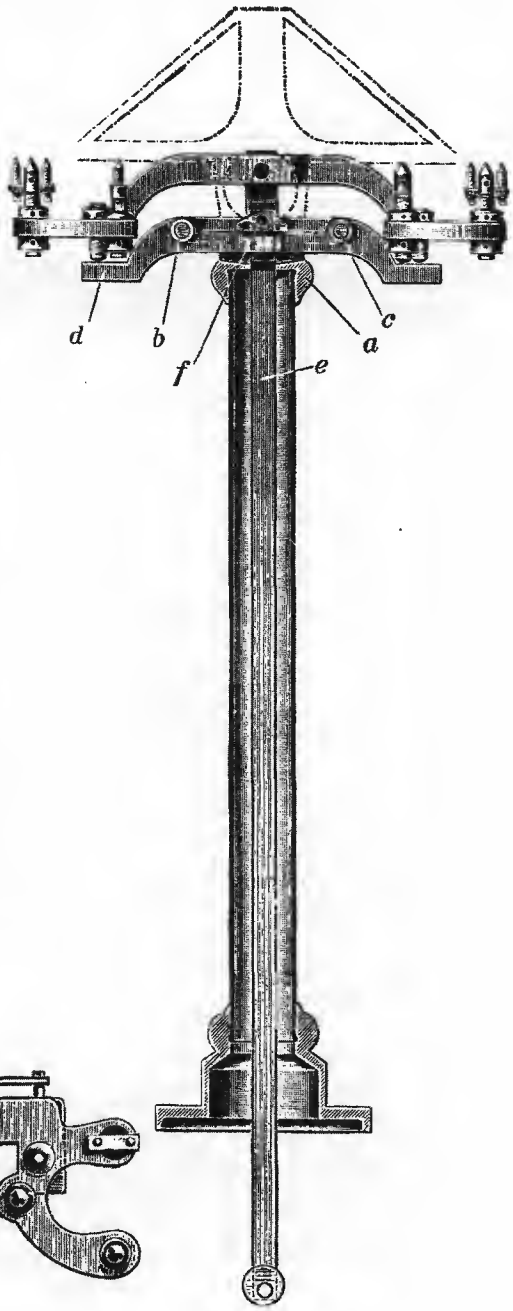
Fig. 5a. ➢➢ Sartorius catalogue of 1929, in which Sartorius denigrates the circular arrestment, and puffs their patent two-part circular arrestment:

The Circular Arrestment.

The universally appreciated circular arrestment was first introduced by Sartorius. In the course of many years' manufacture, the design has been considerably improved and has today reached such a degree of perfection that it is recognised as the best form of arrestment for analytical balances. As the principle of our circular arrestment is widely known, only the important improvements in construction will be described. The vertical rod which raises or lowers the lower arm of the circular arrestment is operated by an eccentric [cam]. The rotation of the eccentric [cam] gives rise not only to a vertical force but also to a considerable horizontal force, which in course of time causes wear of the guides which position the vertical rod, and the latter therefore is forced more and more out of centre.

As a result, the lower arm is lifted on one side and drops on the other, and the wear on the guides is doubled. The supports do not now simultaneously engage with the axes of the beam and the support which first engages with the beam gives it an impact, causing it to slip on its axis. This defect naturally causes wear of the planes and axes and also uneven oscillation.

This fault is completely overcome by the Sartorius patent circular arrestment in which the ***lower support*** *is no longer made in one, but in* ***two parts.*** *The two levers thus formed are supported at the points* **c**. *The illustration shows the lower support* **d**, *journaled in the pillar head cams* **h**, *which can tilt about the axes. The connecting rod* **e** *is pivoted between the inner ends of the bearers and in addition to being guided by the points of support is also retained in position by the two slots* **g** *in the pillar head.* ***The slot guide and the link connection between the lower support and the connecting rod entirely prevent the latter taking up the horizontal thrust of the eccentric [cam].*** *At the same time uneven oscillation of the beam causing loss of time and wear of the bearings is eliminated and in this respect the Sartorius analytical balances show a marked advance on those of other manufacture.*



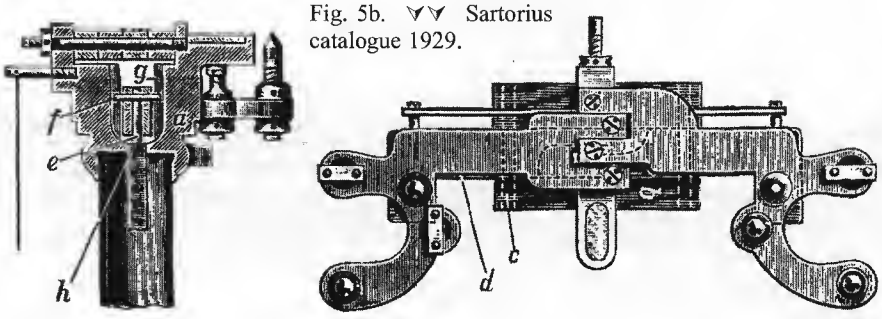


Fig. 5b. ⋎⋎ Sartorius catalogue 1929.

most wear, not the rolling action when in use. If the arrestment arm moves through the same arc as the beam arm, the contact will be gentler with no sideways motion. Therefore the radial arrestment arms have their axis immediately under or, better, behind the centre plane.[11]

All of the above discusses normal single-centre radial arrestment. But the Vacua seems to break new ground, in having a two-centre radial system. This is clearly inferior. Yes, the arresting arms move in arcs, but tighter than those of the beam, so there will still be some sideways motion on contact, albeit less than in a drop-action type. I suspect the two-centre was used on the Vacua to avoid having an arrestment central axis near the centre plane, already a very congested area in this complex design.

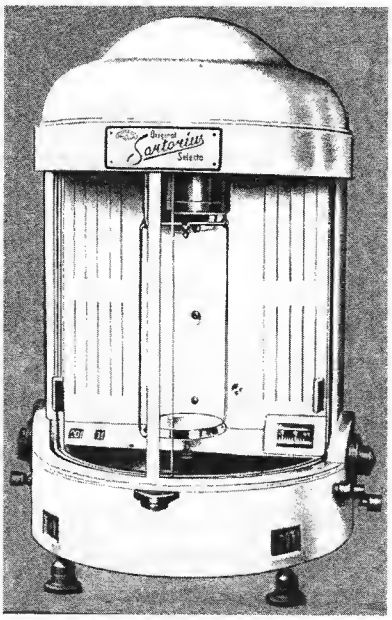


Fig. 6. Sartorius' single pan Selecta. Who knows what interesting mechanisms lie beneath such covers?

So, what happened next in Sartorius balance evolution: one centre or two? The Sartorius Selecta is clearly a greatly simplified Vacua, intended solely as a mass-production straightforward laboratory analytical balance, introduced in the late 1950s. By a wonderful piece of serendipity, it so happened that I was performing conservation work on the Science Museum's own Selecta at the very time we were immersed in the Vacua. When I took the cover off (how I do agree with previous comments on covers/cases!) I was astonished to find two-centre radial arrestment. It was improved in that the arms were longer, to give a more closely-matching arc, and was easier to build and service, in that the arms rotated not on axles, but on spring-loaded ball-and-socket joints. Sartorius maintained their belief in radials, using it in modified form in the next generation, the single pan substitution balances, right up to the end of mechanical balances in the 1970s.[12]

A final surprise: the Mendeléef-designed Oertling at the Standards Dept. may not be the first radial arrestment in Britain after all! Chisholm makes the obscure, interesting comment that the redoubtable Captain Kater directed Robert Brettell Bate to create some such device in a few of the balances Bate made for him! That takes us back to before 1847, even pre-Arzberger et al!! A world first? Following this clue could be a long process, I fear.

Notes & References

1 Mendeléef. This name is spelled various ways, Mendlejew, Mendeleyev, Mendeleev, Mendeléjew,
2 Mendeléef, D I, *Repertorium für Experimental-Physik*, 11 (1875) pp91-93.
3 Brauer, E, *The Construction of the Balance*, 3rd edn, trans., 1909, pl50.
4 Jenemann, H R, *Die Waage Des Chemikers/The Chemist's Balance*, Dechema 1997, p53.
5 *Equilibrium* 642-643.
6 Editor - Christian Becker was trained in Europe and took his traditions to America.
7 Chisholm, H W, *On the Science of Weighing,* London, 1877, pp143-145.
8 Jenemann et al, *PTB Bericht PTB-TWD-38*, Braunschweig 1992, pl5.
9 Mendeléef, D I, *Proc. Royal Society,* LXIII (1898), p455.
10 Birmingham Museum of Science & Industry, acc. no. 1956/727-3.
11 See, for example, the sketch in ref. 4.
12 Personal communication from A W Morris, European Instruments, Oxford.

Circular Radial Arrestment 1888-1965

BY R HOLTMAN

My Sartorius 1896 catalogue' shows balances with double radial arrestment on pages 7-9: models 102, 103, and 104 (this last one being also called Model 1888, see fig. 1). Sartorius seemed to have lost interest (a bit) in double radial arrestment because the 'Model 1896' balances on pages 10-13 omit this feature.

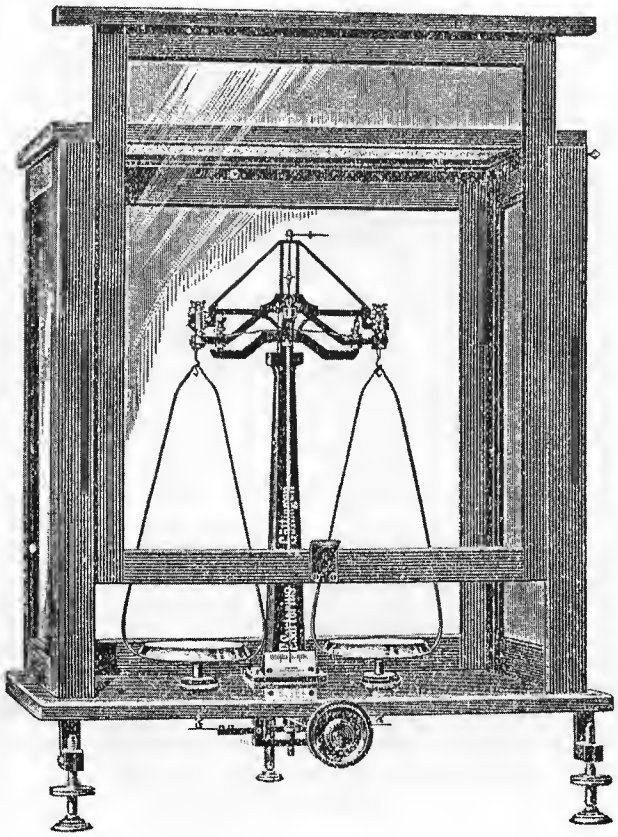
In the Sartorius 1933 catalogue model D1, Analysenwaage Nr. 6 and USA (8b) got 'Kreis-bogenarretierung', [circular radial arrestment] and there are most probably more Sartorius scales with this feature.

The Becker's Sons 1926-1929 catalogue has a couple of balances with this 'cirkelhefboom-arretering' (circular lever arrestment), numbers 1 and 2.

Around 1965 models 1 and 21 (of 1926) went into oblivion, to be replaced by modern-looking models RGH, RGP, RGK. Becker's Sons stopped producing scales around 1967. I've never seen these last three models.

So my information on double radial arrestment goes back to 1888 (Sartorius) and 1900 (Becker's Sons). As Sartorius made the Selecta until at least 1965, we can definitely say that double radial arrestment was used for 77 years.

Fig. 1. ⩛⩛ Model 1888 by Sartorius "A very cheap balance responding nevertheless to the highest expectations, concerning its accuracy and quickness of weighing. Triangular beam with or without a [graduated] scale for the rider; the beam, the scales [pans] and hangers are fitted with an arrestment of a circular movement. Axes and pans of carneol, platinum-plated scales [graduations]. Varnished case, sliding-doors with sash-weights, base of black mirror-glass. This balance is only furnished in two sizes, 180mm (7ins) and 140mm (5½ins).



Notes & References

1. Sartorius 1896 catalogue available on CD in PDF from R Holtman.

2. Becker's Sons 1926-1929 catalogue has a couple of balances with this 'cirkelhefboomarretering' (circular lever arrestment):

1) No. 1, 200 g x .1 mg (price DFL 360) including air dampers (below the pans) and optical projection (readable through a lens) (published in 1929).

2) No. 21, 22 and 23: 200 g x .05 mg / 500 g and 1000 g x 1 mg (prices respectively DFL 270, 310, 380), a simpler model than No. 1 (published in 1926). Exactly the same scale was published under the same model numbers in the Dutch 1919 catalogue (p. 21).

3) No. 24, 200 g x .05 mg (price DFL 290), same scale as no. 21 but in aluminium housing with transparent glass on 5 sides and a black marble base-plate (published in 1926).

4) No. 46 and 47 are accompanied with a picture of No. 24 but I think they were wrong. These balances were based on No. 41 and 43 (published in 1929).

➢➢➢➢➢➢➢➢➢➢➢➢➢➢➢➢➢➢➢➢➢Continued on page 2607

Beginner's Guide Part 2

2. Top-pans

Beam	Straight. Equal arms
Resistant	Weights. Fixed pivot
Resistant	Not attached, ie. loose
Fulcrum	Central. Fixed pivot
Load	Fixed pivot. Pans above beam
Stabilised by	**Linkages below beam, mass below each pan. MAIN FEATURE**
Graduations for equal units	According to weights used
Common names	Roberval, Béranger, Pfanzeder, Schickert's, even-balance or trip scale (USA), counter machine (Britain),

To quote John Knights (EQM 2322) "Someone has taken pride in producing a decorative solution to the apparently mundane task of putting scale-pans above the beam. In reality the achievement was far from mundane, as the placing of the weighing pans above, rather than below, the beam was a fundamental act which changed the scale from a technical instrument into an everyday machine of simple commerce."

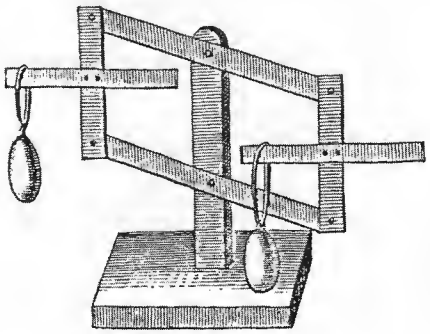
This idea of placing the pans above the beam happened very late in the history of weighing, as late as about 1741AD. Even then, the idea was applied only to platform scales with levers and steelyards, using one flat board for the load. It still amazes historians that the necessary ideas to place the pans above an equal-arm beam had been available since 1669, and even published as drawings placed alongside drawings of practical balances, yet were not constructed.

Roberval's Static Enigma

Giles Personne de Roberval demonstrated a pair of beams, one mounted above the other, and linked by "legs" at their extremities. Two matching loads could be placed on extensions (of the same mass, but not necessarily of the same length) to these legs, one load much further from the fulcrum than the other, and yet they still balanced. How could this be? The system was called "Roberval's Static Enigma". Roberval even looped one extension right across, until both extensions were the same side of the fulcrum, and placed matching weights on those extensions. It still balanced.

The key to understanding the enigma is to think about where the load presses down. The load is hanging on the leg, whatever shape that leg is. That leg may have protruding bits, sticking out away from the fulcrum, or pointing towards the fulcrum, but always the pressure is taken by the leg. The leg is attached to the top-beam, pulling it down, and to the bottom-beam, pushing it down. So where-ever the load hangs, (as long as it is hanging from the leg), the load is truly being applied to the bearings on the end of the beam. If the bearings are at equal distances from the fulcrum, we have an equal-arm balance.

Fig. 1a. ➢➢ Drawing from Leupold's book published in 1726. The German text calls it "*a curious scale... .invented by Herr de Roberval, King's Professor at the University of Paris, published in The Journal of Knowledge 1670*".



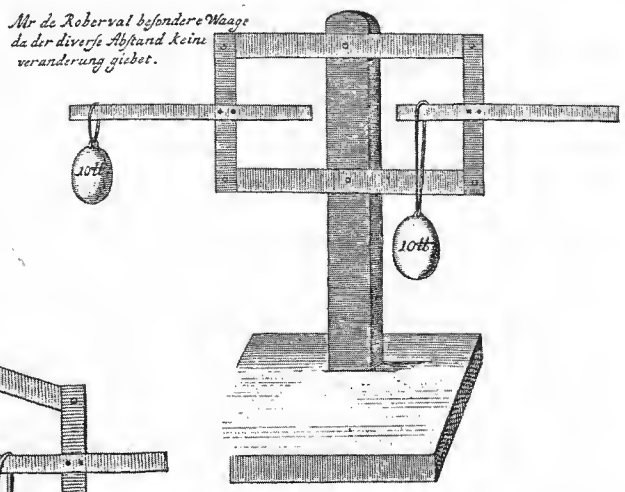


Fig. 1b. ≺≺ Drawing from Leupold's book published in 1726. The right-hand weight is heavier than the left-hand weight, pulling down the right-hand leg of Roberval's parallelogram.

Top-pan counter scales

The pans were put above a real equal-arm beam somewhere around 1800AD, in England. These machines rapidly became popular, and variations were available well before 1828, when illustrated advertisements show the scale-makers trade-wares for the first time. The diagrams show only a flat side-view, but each pan need two knives, one each side of the beam, to stop it toppling over. Sometimes the beam split under the pan and one knife was put through each side. Sometimes a separate cross-brace went under the pan, with a knife at each end. Looking at real robervals, it is easy to see the bearings under the pan because the bearing must be close to the edge of the pan. Some robervals have two beams along the top, linked by cross-braces, so technically they operate as one beam, but they provide widely spaced knives for the fulcrum and the end bearings. The fulcrum may be in the middle of a single beam, and hidden by frame-works or ornamentation.

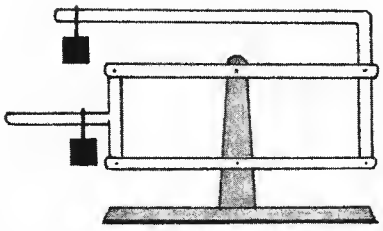


Fig. 2. ➢➢ Drawing of Roberval's second experimental model,

George Medhurst Inventor??

Professor Robert Willis used half a roberval linkage in his patent of 1840, stating that the letter plate should be above the beam *with the link below, in the manner of the common Medhurst pan.* So George Medhurst may have been the first to manufacture roberval scales. He was working before 1799 and worked until 1827 on various engineering projects, many of which he patented. It seems curious that Medhurst did not call them *Roberval Scales,* but called them *Patent Scales.* Was he unaware of Giles Personne de Roberval? Was the invention independently made around 1800? When was Roberval' name attached to the scales?

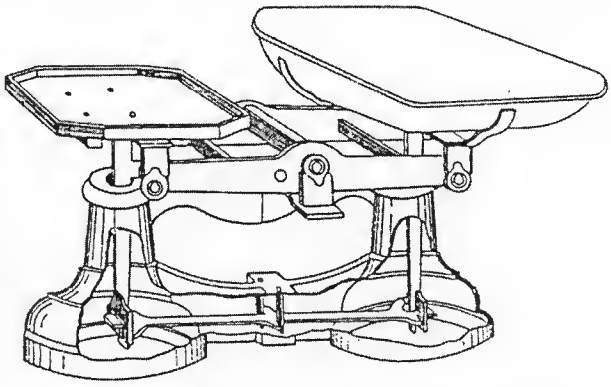


Fig. 3. ⮙⮙ Roberval scales with the casing cut away

An undated advertisement of George Medhurst's explains to the customer how to use the machine, as if people were still unaccustomed to top-pan scales. *The Patent Scales are used in the same manner as the common Scales; the weights are put on one board & the Goods upon the other & the weights are the same in all respects as those in common use.* His claim of patent scales has not been confirmed, but he held patents for other items, and it was not illegal to claim a patent! He also stated *Their reputation is established upon the unerring & invincible testimony of above four thousand Purchasers who have purchased it abundantly proved their pre-eminence in point of convenience, precision, care and expedition, their steadiness, simplicity, safety & durability, the little room they occupy, the ease & facility with which they are moved, and the time & labour they save in the operation.* After reading that, who could resist?

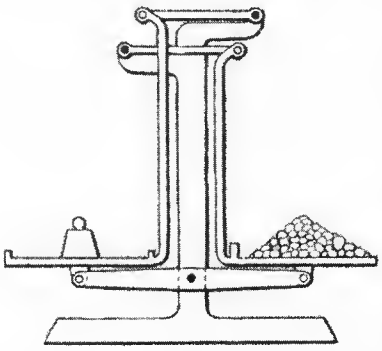


Fig. 4. ⮙⮙ Inverted roberval, called an Imperial. This is still technically a parallelogram, but the top linkage has been cut in half and overlapped to make it more compact and the legs have been bent in towards the pillar.

Why did they become popular? It was difficult to place awkward loads, such as slippery butter, greasy meat, powdery flour or rolling eggs between the chains of a hanging pan without disaster, and difficult to clean the pans afterwards. How much more convenient to have the pans freely accessible, either flat, or slightly dished, or even a deep scoop! A quick wipe over the pan and weighing continued. The early pans were made of brass, copper, tinned iron, ceramic, marble or pewter, any material that was resistant to damage, easy to clean, hard to contaminate, and not too fragile.

Inverted Machines

Those same makers advertised inverted machines for heavy loads between 112-lb (1 cwt) and 20 cwt. As they were a modified roberval system, there was no lever built into the system, and weights of the full amount had to be loaded onto the machine. Hard work but reasonably accurate! The Americans never took to those machines, preferring platform scales with a steelyard for the same purposes, as did many British traders. Europeans preferred their decimal platform

scales (quintenz system, to be discussed in a future Guide.) These latter machines had the advantage of needing only small proportional weights, but were less precise unless very well-made, as any error was proportional too!

Inverted robervals LOOK unequal, but the basic beam across the middle under the pans is equal-armed, and the pans are equal in weight even though they are unequal in size. Most makers called these machines "Imperial or Inverted" by c.1880; again, no use of the name Roberval. The linkages had been split, putting the main beam below the pans, and the secondary beam (divided into two short pieces) above the pans, a system that remained in use until the 1960s.

Even-balance scales

In the USA robervals were called "Even-balance scales", and aimed at small shop-keepers, grocers, butchers, and bakers. Usually they were modified to have a bar along the front, either to indicate the smallest divisions of weight (say, 1/4oz.) or to tare a container and bring the scale back into balance before use.

Naming the roberval

When was the name "Roberval" attached to the scales? The earliest reference found in a British document is in a patent application by P A Brussaut in 1857. The earliest catalogue reference is in the 1880 catalogue of W & T Avery, in which they subtitle their "*Light Pattern Counter Machine (Roberval's principle)....*" and further on, call their "*Best Quality Counter Machine (Beranger's principle)....*" This implies that no special name was applied in Britain until they needed to differentiate between the various linkages.

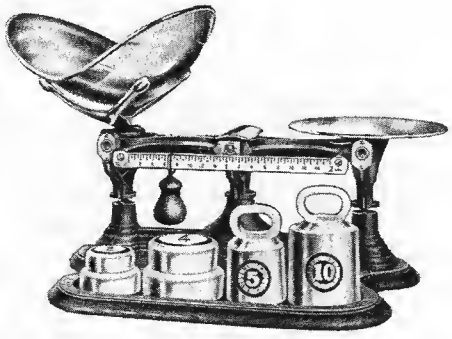


Fig. 5. AA American roberval scale with a bar along the front, with a poise that indicated the sub-divisions of a pound. Unusually for a trade scale, the base has been extended forwards to provide a stand for the weights.

Modifications were needed, because the knife-edges on robervals were placed on the end of the beams which bore against a flat plate on the leg, whereas, to maintain accuracy, the leg should have carried the knife-edge and the beam the bearing. Eventually French and American designers did achieve this relationship between legs and beams on their robervals, but the British roberval very rarely did. In other words, lateral forces pushed and pulled on British machines. The whole mechanism rotated round a centre point, and the single pointer swayed from side to side. (If any part of the linkage was encased, large holes had to be left so that the legs could move in an arc around the centre-point and did not grate against the case. This large hole is another identifying feature of robervals.)

Joseph Béranger of Lyon first applied his engineering skills to improving *Balances Anglaises* in 1840, clearly labelling them *Balances Roberval* in his advertisement of 1842. (The French education system ensured that he knew about the Énigme Statique!) Béranger was attempting to cure the problem of the stresses between the legs and the bottom stay (or beam). See EQM 2483-5 for details. Béranger was never satisfied with his solutions and moved on to create the system named after him, but Westphal and then Wimmerlin in 1853, did manage to greatly reduce the stresses in the bearings, and on the Continent their versions of the roberval were used from then on. Robervals were no longer acceptable for trade in Germany by 1905.

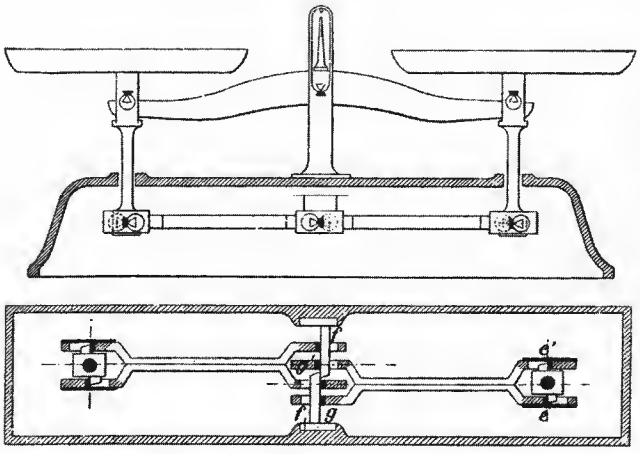


Fig. 6. AA Westphal split the bottom linkage into two and put extra knive-edges in the middle.

Readers trying to identify roberval scales can usually be sure they have a roberval if there is space between the beams and the legs, such that the parallelogram is empty except for a support pillar. This "rule" holds good except in one circumstance, that is, if two pointers are mounted HALF WAY UP the legs to cause the pointers to meet when the roberval is balanced. Double pointers were

extremely rare on robervals, being a feature of berangers, so it is necessary to check to see what is filling the parallelogram.

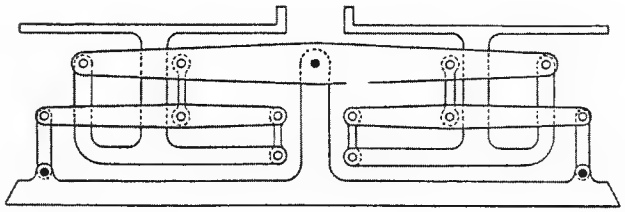


Fig. 7. ⅄⅄ Béranger's system, with the extra short beams horizontally across the middle.

Joseph Béranger

Joseph Béranger invented his *Pendulous System*, known to us as beranger scales, in 1845. He cleverly contrived to apply all the forces vertically. This gives a delightful "floating" movement when a pan is depressed. The pans rock gently up and down for a considerable period (far longer than any roberval scale), proving that the friction on the bearings is minimal. As the movement is vertical, any two pointers attached to the TOP of the linkage will pass each other neatly, showing which pan is heavier. The parallelogram has extra short beams half way down the legs, so the space is filled. But only the top-beam crosses the centre; no legs, stays or parts cross over the centre of the machine.

Georg Pfanzeder

Emphasis has been put on the beranger having sub-beams isolated on each side of the fulcrum, because the distinguishing feature of the pfanzeder system was the oblique stay that conveyed the downward movement of the inner edge of the pan to the sub-beam on the opposite side of the fulcrum. This oblique stay causes any movement down on one side to be exaggerated by forcing the opposite side to move up strongly. This oblique connection crossing the centre was developed by Georg Pfanzeder of München in 1864 and by the Pfitzer Brothers of Oschatz in 1867.

Pfanzeder protected his patent by writing to get the Pfitzer's patent nullified, and the Saxon Ministry of the Interior eventually decided that Pfitzer could keep his patent as it had less than a year to run, but that the system would henceforth be known as Pfanzeder's system! That is why both names are used in referring to these oblique-stayed scales. In the patents the system is called the "*Three-beamed scales*" as there is one long beam going right across under the pans, and two short beams, one under each pan. Béranger's scales also had three beams, so the "family" connection between the various Béranger's, Pfanzeder's and other modifiers' versions were made clear to readers of Continental patents.

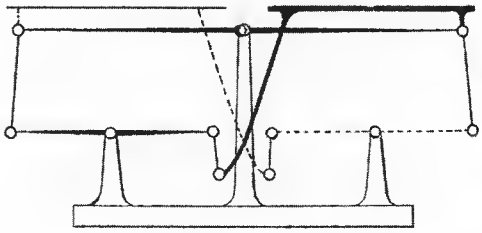


Fig. 8. ⅄⅄ Pfanzeder's system, diagrammatically. Note the oblique stays crossing the centre pillar.

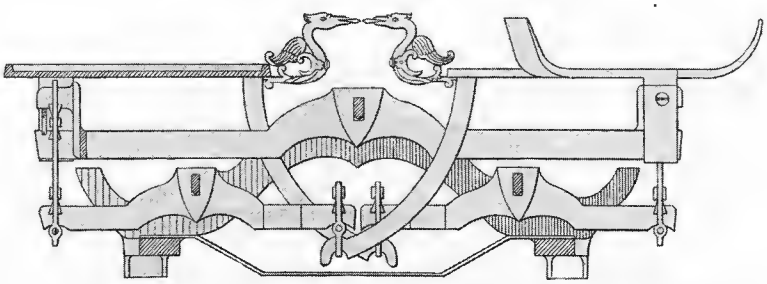


Fig. 9. ⅄⅄ Keppler's variation on the pfanzeder system. The left-hand oblique stay goes across behind the scale, as seen from this view, and the right-hand oblique stay goes across in front, as seen from this view.

Variations

Each company liked to have its own subtle variation on a system, eg, Schember had a rather angular version of the pfanzeder system. Westphal almost turned his robervals into three-beamed scales by splitting the bottom "beam" into two separate beams. See Fig. 6. Keppler slightly modified Pfitzer's three-beam counter scales. Krups made the Krups-Roberval and the Adler-Roberval.

London bridge versus French centre pillar/support

The British favoured a bridge under the top beam, to support the central fulcrum (Editor: think of the London pattern as the London Bridge), whereas the French favoured a central pillar to support the central fulcrum. The London Pattern was an accelerating beam, much used prior to 1850, but was still offered for trade use in 1889. The French pattern that vibrated was first manufactured around 1880.

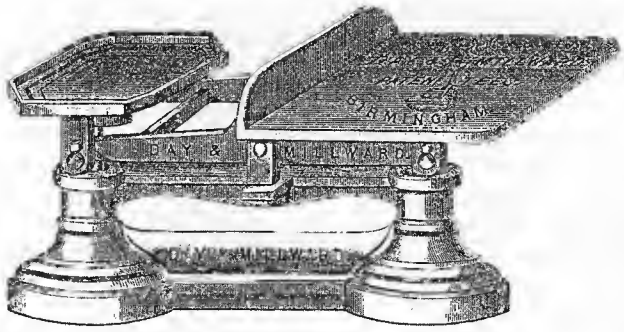


Fig. 10. ⅄⅄ Day & Millward, Birmingham, 1889 catalogue. Classic London "Bridge" pattern, accelerating beam.

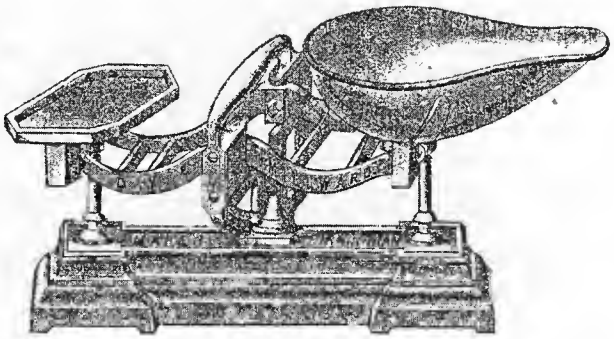


Fig. 11. ⅄⅄ Day & Millward French "centre support" pattern, vibrating beam. Note the handle to carry the scale.

Vibrating or Even, Accelerating or Tripping?

The business of vibrating or accelerating beams needs clarifying. If a beam has the three knife-tips exactly in a horizontal line, the beam vibrates, rocking back and forth whether unloaded or loaded, called by the British "*Vibrating*" and by the Americans "*Even*". If the fulcrum is manufactured lower than the end-tips the beam is called by the British an accelerating beam; the beam rests on the left side, only rocking when loaded, starting to move slowly, and accelerating as the load takes over and dropping noisily onto the rest on the other end. The Americans call them "*Trip Scales*" a name that explains clearly that, once the load is applied, the beam is tripped and swings over to rest on its other end. It is usually designed so that the beam rests on the right side when a full load is applied, and thus the customer and the user are satisfied that the customer is getting full weight. On checking accelerating beams, it was impossible to see with the naked eye that the fulcrum was lower than the end bearings. It was only by applying a straight-edge along the knives that it was possible to observe that the centre-knife-tip was a millimetre lower than the ends on beams 8-12ins (200-300mm) long.

Torsion Balances

This name causes problems, because using torsion (the twist in a wire) has been applied in two ways. Very precise analytical balances have a single wire, acting as a resistant. That type is not applicable here. But wires can be wrapped round frames to operate as bearings, and these are relevant.

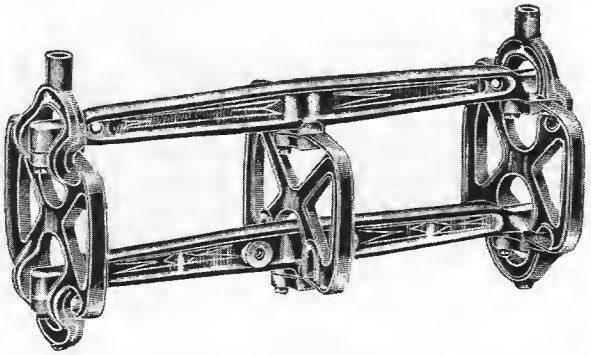


Fig. 12. ⅄⅄ Torsion Balance mechanism, showing the three trusses around which the wires were wrapped.

Frederick Roeder

Bearings have always been a source of problems for scale-makers, users and repairers. If sensitive scales could be made without the need for sharp edges which loose their sharp point, that tend to slip on the hard bearings, and are difficult to get exactly parallel and in line, what a benefit!

Dr. Frederick Roeder of Cincinnati came up with an alternative. [See pages 2610-2615.] He envisaged the beam soldered to a taut wire or ribbon, so that after the beam had tipped (twisting the wire slightly) the wire would return to its flat horizontal position. The end "bearings" were twisting on wires wrapped round rectangles used instead of legs. In 1882 he invented his first attempts, and by 1889 his ideas were being improved to the point where collectors might recognise Torsion Balance Co. scales. By 1916, patents show that the system was practical and being manufactured in large numbers. The company is still producing counter scales of considerable sensitivity for laboratory use. The scales are more sensitive than equivalent pfanzeder scales, but, if the wire snaps, many users throw them away.

Schickert's principle

This sub-group has been left until last, (even though it was first used in 1839), because although it has top-pans, the pans are not held in position by parallel linkages. The pans are held by a heavy lump swinging on legs fixed to the bottom of the pans. The lump has to be heavier than any load that might be put in the pans. If the lumps were lighter,

the pan would flip over, dropping the load. The system is adequate for specific loads (a coin or a letter) but cumbersome for counter scales, and has rarely been used commercially.

Schickert's name has been attached to this principle by Brauer and other authors, even though the system was used before Schickert was born. (Schickert personally discussed his system with Brauer some time prior to 1880, when Brauer wrote his book.) The system turns up occasionally; one suspects that each inventor believed that he'd hit on a new solution to providing top-pans! It was used by W Lund in 1839, I Brown in 1842, Stephenson Howard & Davis c.1844, Fairbanks in 1859, Maranville in 1878, Schickert c.1870, M Mark in 1894, Automatic Scale Co Ltd in c.1927, and White Mfg. Co. in the 1920s

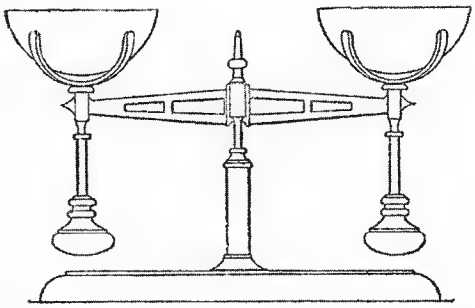


Fig. 13. ⮝⮝ Sckickert's principle. Patent drawing submitted by Marks, Liverpool in 1894, for a shop scale. It was made in small numbers.

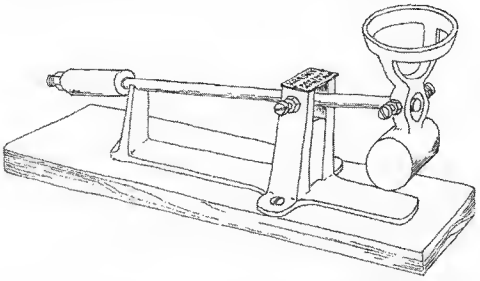


Fig. 14. ⮝⮝ American schickert principle, Kresky egg scale. Drawn L Costa

Conclusion

Traders would not have stopped weighing if top-pan scales had not been invented, but they would have been slower doing their weighing for 150 years. Many sub-groups of scales, that utilise half a roberval linkage (to be discussed in a future Beginners' Guide), would never have been made.

Private users would have been deprived of thousands of decorative letter scales that gave presence to their desks, and many ISASC members would never have started their hobby if they hadn't been attracted to robervals!

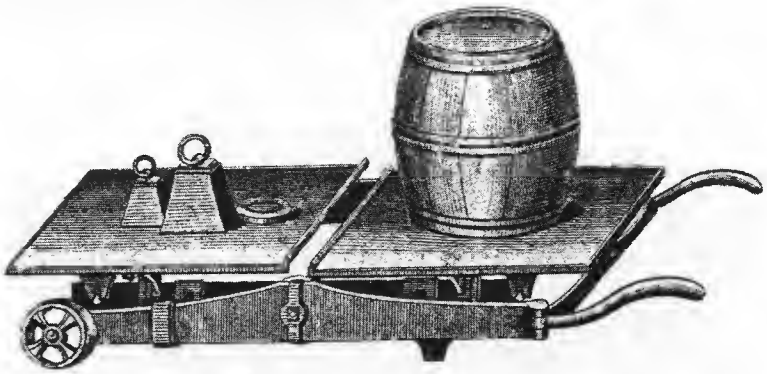


Fig. 15. ⮝⮝ W & T Avery, c.1840. Very flat roberval. The beam is hidden behind the "wheelbarrow" frame. Weighed up to 30cwt (3360-lbs.)

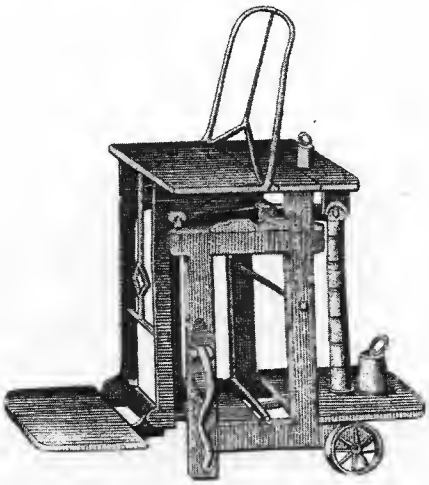


Fig. 16. ⮝⮝ W & T Avery c.1840. "Double machine" with plates at the top for light weighing, and plates at the bottom for heavy weighing up to 448-lbs. Classic inverted roberval with the beam at the bottom, stays up the sides and the secondary beam (linkage) across the top, forming a parallelogram.

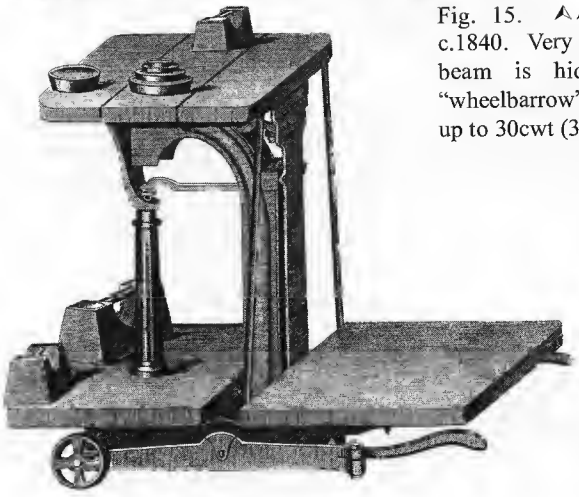


Fig. 17. ⮜⮜ W & T Avery c.1840. The beam is equal-arm, at the bottom. The fat pillar on the right has been placed to the right side of the centre fulcrum. It holds the top-stays that have been divided into two, and overlapped. Later called an Imperial machine.

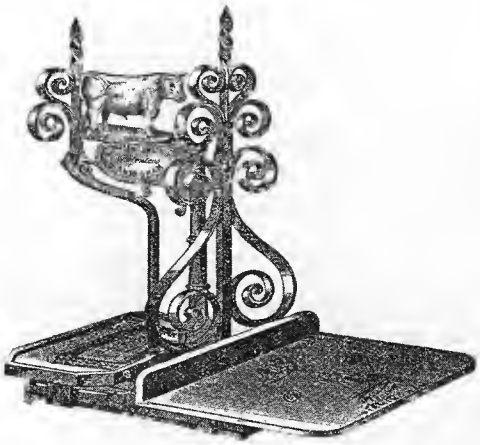
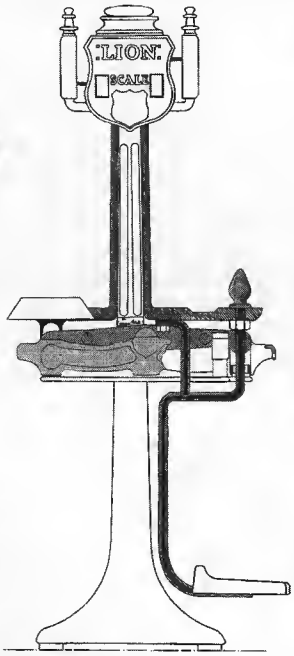


Fig. 18. ⋏⋏ Day & Millward 1889 *London Pattern Imperial or Inverted Machine for butchers.* Accelerating

Fig. 19. ⋎⋎ Herbert & Sons Ltd 1930 inverted roberval with hanging pan. 4-lb capacity for weighing butter. Designed to protect the bearings of the goods pan from saline drips.



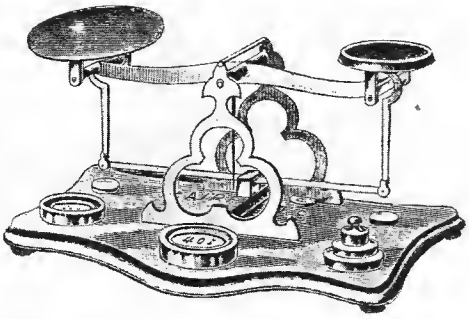


Fig. 20. ⋏⋏ Americans generally used half-roberval & steeyards for postal use, but this one roberval was offered in the second half of tbe 19th century. It was a plain version of numerous British postal scales and possibly was imported.

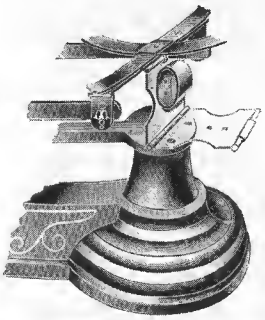


Fig. 21. ≺≺ One of several locks designed to arrest robervals when in transit. Because robervals were used on market carts, the bearings lasted much longer if they had robust locks.

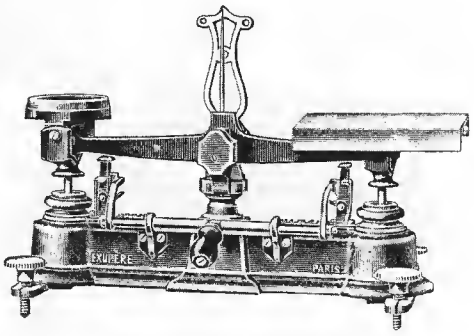


Fig. 22. ⋏⋏ Exupere of Paris, (successors Aubry & George) c.1928, roberval for extra-heavy duty use.with locking mechanism.

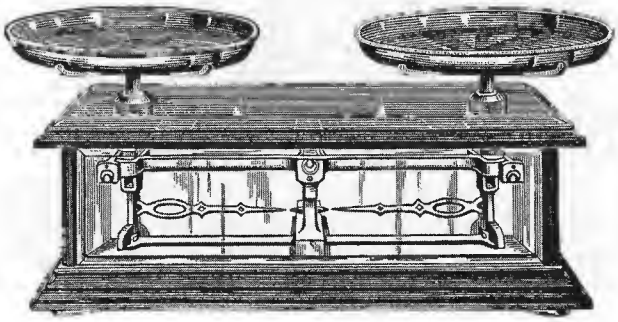


Fig. 23. ⋏⋏ Henry Troemner 1899 roberval, made to look like a Torsion Balnce Co. scale. The pointers are mounted halfway up the legs, in the manner of the pointers on beranger scales. Agate bearings which will "*last a lifetime without repair*"!!

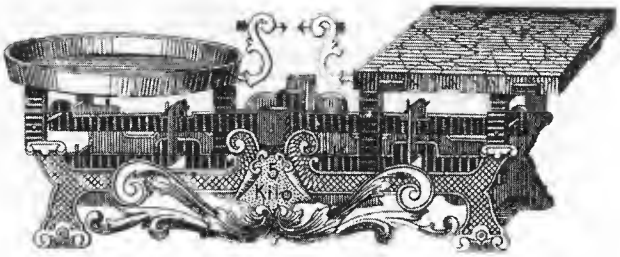


Fig. 24. ⋏⋏ Barmer Waagenfabrik (A Aug. Freudewald) 1907 counter machine with marble load-plate. Single beam with beranger sub-beams below. No stays cross the centre. Smallest version 1 kilo capacity. Largest version 25 kilo capacity.

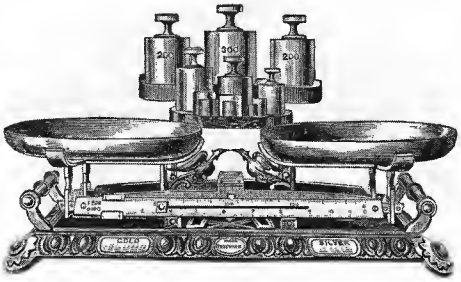


Fig. 25. ≺≺ Henry Troemner 1903 Specie Scale designed for banks. Beranger. *The side-beam has 4 graduations - for Gold, Trade and Standard Dollars and subsidiary coin.. Tables give the weight of gold coin in drafts from $5,000 to $100, and the other gives the weight of silver in drafts of $1,000 to $50. Supposing we desire to weigh $5000 in gold, we look at the table and find the weight required 268.75; we place the 268oz in the right-hand pan and slide the oz. poise to 75; then put the coin in the left-hand pan. Should the coin weigh light, we slide the poise B along the beam until the scales balance If this takes place with the poise at say 20, it signifies that the coin is that many dollars short.*

Fig. 26. ➢➢ Pfanzeder counter machine dedicated to Elisabeth of Austria by C Schember & Sohne before 1888. The stay that is normally oblique has been shaped into a vertical strut that turns at 90 degrees to cross the centre. A simple version, with the same mechanism, was made for trade use.

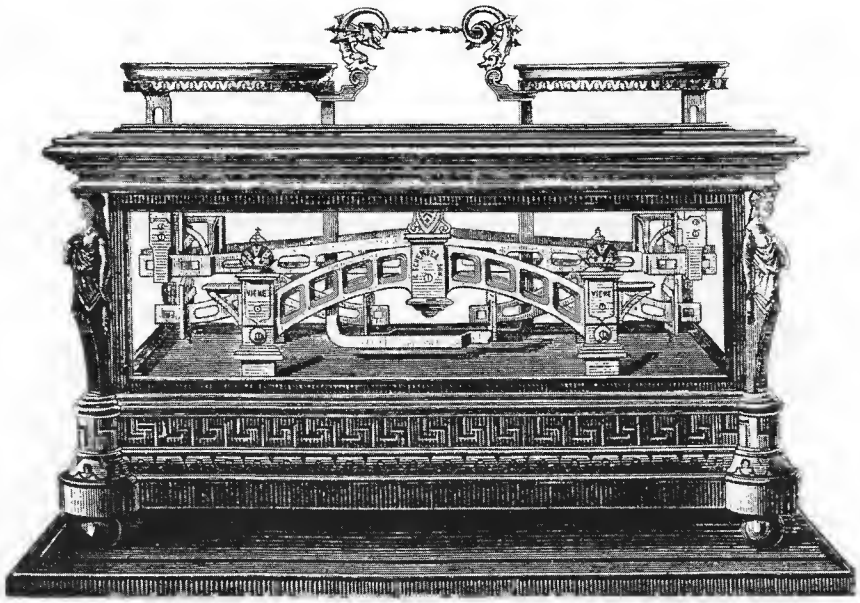
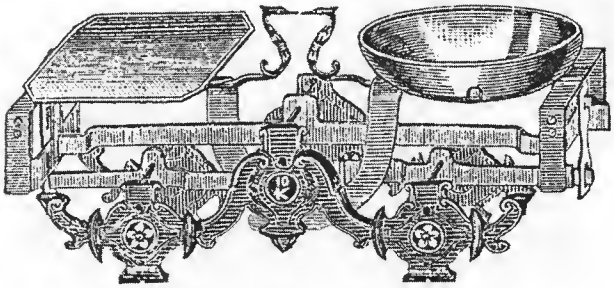


Fig. 27. ⋎⋎ Kopp & Haberland 1888 pfanzeder counter machine, permitted for trade use. Very few German companies used the pfanzeder system, as most used the beranger system. Single top-beam. Small versions capacity 1 kilo. Large versions capacity 50 kilo.



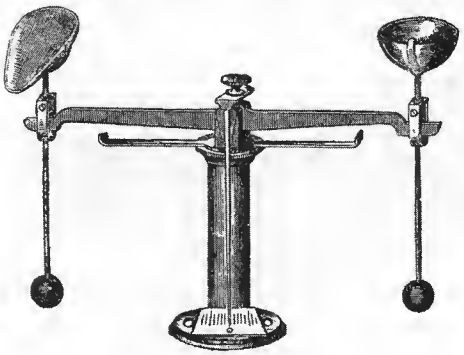


Fig. 28. ≺≺ Stocker's Dispensing scale, c.1880. Schickert's principle. Capacity 10gms for Germany. Sold by Herman Kohlbusch in 1902, capacity 1oz for use in the USA.

Fig. 29. ⩓⩓ Torsion Balance Co. 1922. One of several machines with exposed parts. *Moisture balance; a direct reading of the per cent of moisture after evaporation can be made without the use of weights.*

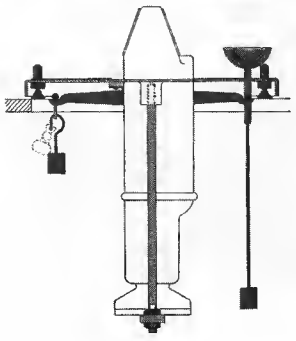
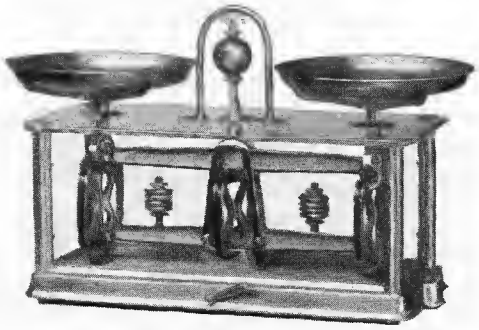


Fig. 30. ≺≺ Automatic Scale Co Ltd in c.1927, to weigh tobacco in a factory. Schickert's principle. The user saw only the pan and the graduated chart as the rest of the mechanism was below the counter.

Fig. 31. ➢➢ Torsion Balance Co. 1922. Laboratory balance, capacity 10-lbs, sensitiveness 1 grain. No tare bar. Poises above the bottom beam that could be adjusted at the factory only.

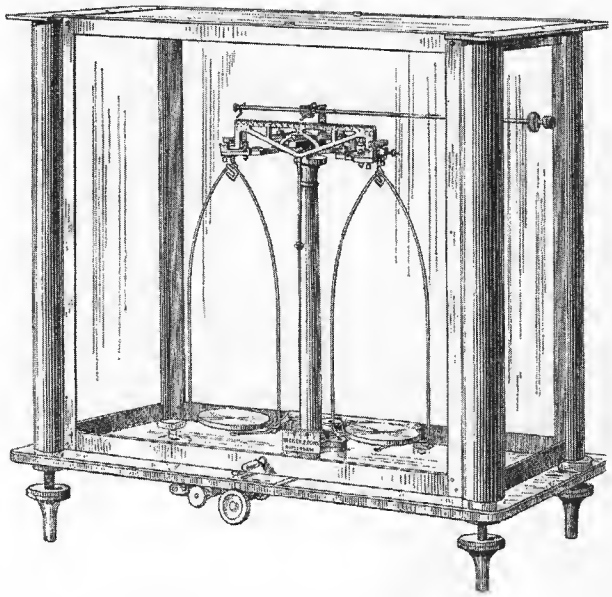


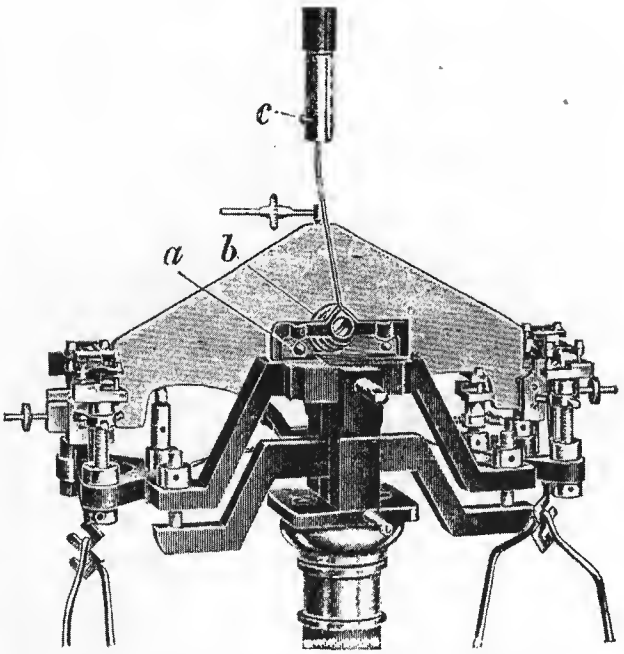
➢➢➢➢➢➢➢➢Continued from page 2598.

Fig. 2. ➢➢ Sartorius circular arrestment and compensation hangers on their 1922 new quick-weighing analytical balance. Beam 5½ins (140mm), capacity 200grams. Of 30 equal-arm balances in the 1922 catalogue, 8 had circular radial arrestment, 14 had parallel arrestment and 8 had lever lift.

Model 19aa was also published in '*Wereldkroniek*' nr. 33, 7th year, of 17 Nov. 1900, when Becker's Sons showed this scale during the International Exhibition at Paris in 1900. And it appeared again in the Dutch version Becker's Sons catalogue of 1919, page 26 (no. 44).

Fig. 3. ➢➢ Becker's Sons 1913 French catalogue, no. 19aa, aluminium beam with double radial arrestment. *Nouveau systême d'arrête pour les plateaux et le fléau*





Notes & References continued from p 2598

Model No. 1 and 21 were also published in a little 1932 Becker's Sons catalogue.

In a leaflet dating back to 1940 model No. 1 of 1929 was changed a bit: the lens was removed and the graticule was projected on a matt window, just below the central knife. Model number was changed to 1G (standard model), 1GN (including vernier graticule), and 1GR (model 1G with rider). It clearly shows the principle of double radial arrestment.

Model 21 and 24 also figure here, again with 'cirkelhef-boomarreteering'. A leaflet most probably dating back to 1951 shows the same models again.

The casing changed and was modernized; its contents remained almost the same during the 1950s. Around 1957 model 1GRN was added (with Vernier graticule and riders), model 21 was still there while model 24 stopped.

Editor: Most of these catalogues are available on CD in PDF from Ritzo Holtman.

Carters Standard

BY J BERNING

In the summer of 1994, on a mid-week day, as Bill was doing his rounds servicing his scales, he took a break in an antique mall to look for scales, as is his habit. Bill, being quite good at scale spotting, saw an interesting scale that he didn't think he'd ever seen before. He asked me about it but I was not paying much attention to his description. Later that evening, on the sly, he called another collector to ask her opinion on the scale. She told him that it didn't sound familiar and that it may be a very rare scale. The next day he again mentioned the scale to me and I listened more carefully to the description. I told Bill that we should go buy the scale as soon as we could. The following day was Saturday and we had just enough time between the kids' soccer games to travel

the 30 miles to get the scale. Would it be gone?

We got to the antique mall and, not wanting to seem too excited, we took our time to get to where Bill had seen the scale a few days before. The scale was still for sale. I was amazed at the interesting mechanism. The scale was cast-iron and had about 70% of its original red paint with gold and black details. It had a common fish-tail base and an ordinary spider on which a scoop rested. The stand was unusual in that it was cast in two pieces and riveted together. On the front of the stand casting was the word CARTERS and on the back was cast STANDARD. I noticed the unusual ice-cream cone shaped counter-weight and the poise. When the poise was moved along the beam, the brass dial on the front of the poise rotated to different numbers to show the weight from 0 to 18. This WAS a very unusual scale and I knew that I must have it! Bill bought it and we admired it all the way back to the soccer field.

The following May, at the Hershey, Pennsylvania convention, while looking through albums of other collections we saw a scale, owned by another collector, which was similar to our Carters with one exception, it had a flat plate rather than our scoop and spider. We talked to the other collector and found that she had gotten her Carters in the last year as well. We asked if she had any additional information on the scale or its maker. Since she had none and her scale had been almost entirely repainted, we assumed we'd never know or be able to research it further.

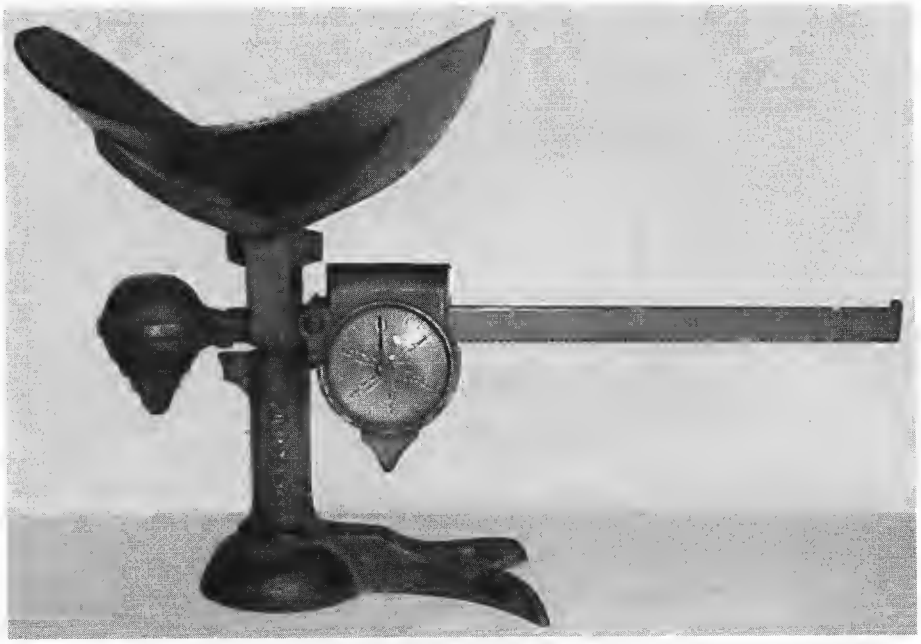


Fig1. ⅄⅄ Carters Standard Counter Scale, with rich maroon finish. The scale was intended by Carter for light use in stores, factories and households.

On about April 22 of this year I was per-using Ebay looking for more scales to buy, or try to buy, when I saw a listing titled "CARTERS STANDARD copper dial." Curious as to what it might be in a scales search, I clicked the mouse on it. There, in a small photograph, was a Carters scale with a flat plate.

In spite of the fact that it looked as if it had been repainted in army gray color, I had to have it to go with the scoop version I already had in the collection. The problem was that the auction didn't end for 5 more days, but there were no bids as yet. On the afternoon of the 5th day, I went back to the Carters listing and learned that another scale collector had bid on the scale. I hoped I still had a chance to get it and that it wouldn't cost too much. I later put in my highest bid and hoped

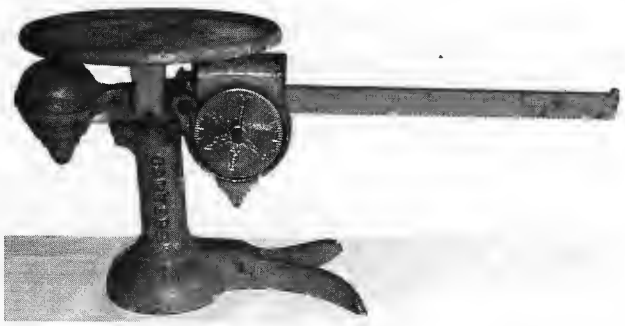


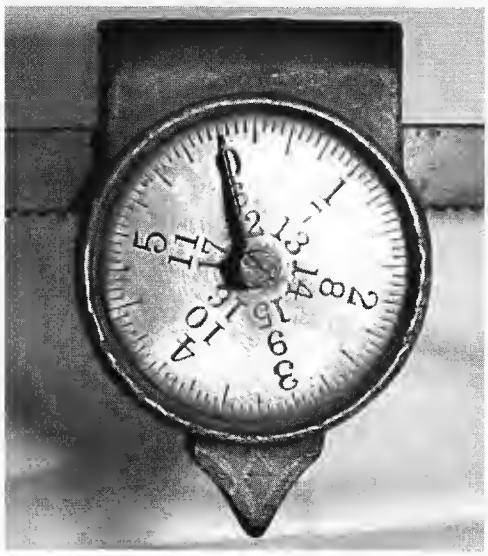
Fig. 2. ➢➢ Carters Standard Counter Scale, with robin's egg blue finish now, but originally black. Note the unusual shape of the poise that is balancing the mass of the beam.

that I wouldn't see the dreaded message "You have been out-bid by another bidder!" The auction ended a few minutes later and I had won the scale! I immediately wrote the seller so that I could get the scale before this year's Chicago convention. Three days later I still had not heard from the seller and time was getting shorter. I got his telephone number from Ebay and gave him a call. He was glad I called because his computer had been hit by lightning and had been down for days. I explained to him that I needed to get the scale as soon as possible because we were expecting ISASC members to visit our home to see our scale collections both before and after the Chicago convention. I mailed a money order that afternoon.

On the 9th May the Carters scale arrived in the mail! Our first visitors had already arrived to see the scales and were just in time to watch me open the package. We immediately placed it on the shelf next to our Carters Standard scale with its scoop.

After the convention was over this year we were looking at the two Carters scales together. The plate of the flat version, we noticed, would come off easily in order to better compare the scales. We unscrewed the single screw and removed the plate. As I was turning the plate over to clean it I noticed that the original color of this one had been black and there on the bottom of the plate in gold lettering were the words PATENT PENDING. I had recently learned that copies of patents could be copied from the US patent office on the internet. I asked Bill in what year I should start my search for the Carter patent. He suggested 1883.

On the second day of my search I had finished the 1883 patents with no luck. I continued with 1884, starting from the latest patents dated December 30, 1884. I opened the second one and immediately recognized the poise of the Carter scale. The title was C D CARTER *Poise For Scale Beams*. This answered several questions that we had had for several years. We learned that Charles D Carter of Detroit, Michigan was issued patent number 309,925 and that he had assigned the patent to Henry C Hart Mfg Co of Detroit. We were also able to get a copy of the patent drawings in order to see how the scale works.



What did the Henry C Hart Manufacturing Co. produce and what years was it in business? A quick call to Dave Poremba, a curator of the Burton Collection at the Detroit

Fig. 3. ➢➢ The poise of Carters scale. The brass face is clearly stamped with the graduations. It indicates 18 pounds by ounces. The pounds are indicated by numerals and the ounces are indicated by hash marks. The marks for the 1/4 ounces are smaller than the one ounce marks and the half ounce marks are longer than the 1/4 ounce marks. Slight pressure on the poise made the dial turn smoothly, without handles. The pointer does not move.

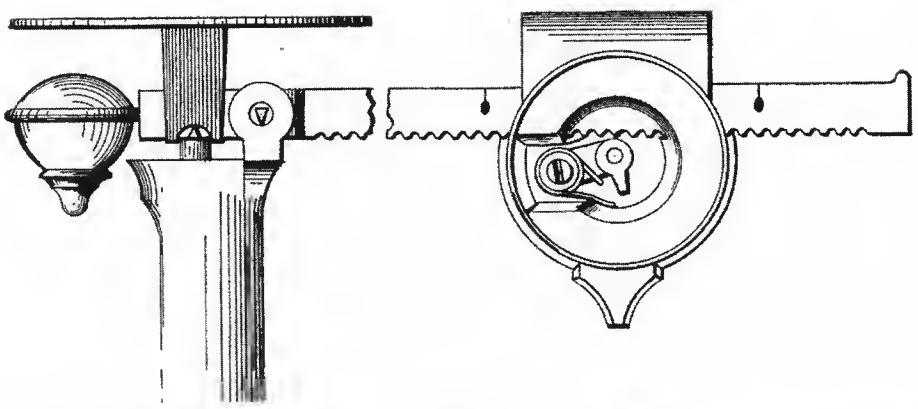
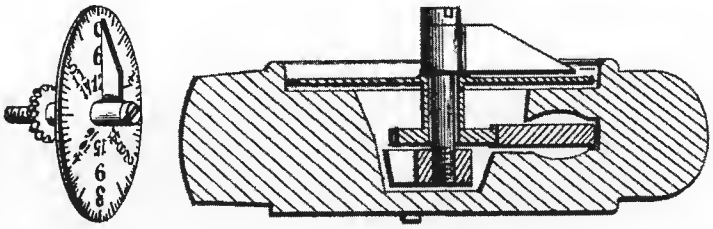


Fig. 4. Carter's Patent drawings. The poise has simple internal gearing held against the beam by a coil spring. The gearing rotates the dial, not the pointer, which is stationary. As the poise moves in line with the beam, and not like a micrometer (round the beam) the divisions are not very fine, but they are suitable for store use.



Public Library, helped a lot. He sent a copy of page 141 of *Detroit in History and Commerce*. This publication of 1891 contains a history of the Henry C Hart Manufacturing Co. The company was founded in 1879, and in 1891 had 450 employees and an annual output of $275,000. The Hart Company made railway, cabinet, and special hardware in a five-storey building at 492-512 Franklin Street in Detroit. We do not know if the scale was manufactured by the Hart Company. However, their buildings comprised a main building, foundry, and out-buildings which would have enabled them to produce scales.

Some questions remain. Who was Charles D Carter and why was he interested in a better scale poise? When was Carter born and where and when did he die?

Author's Biography see page 2140
Editor: Patent search: http://www.uspto.gov/patft/index.html

Developing Torsion Balances

Early Struggles

BY D CRAWFORTH-HITCHINS & R LEADBETTER

Torsion is involved in all types of spring scales (mancurs, V-scales, helical spring balances etc). These require stability of metal properties over time, since the extent of the distortion measures the weight load, (that is, forms the resistant). It is amazing that such stability is at all possible (although it was not accepted as stable in all countries) but the existence of Chatillon and Salter et al surely proves their efficacy! On the other hand, what the Americans call *Torsion Balances* use torsion wires simply to reduce or eliminate friction. Hence maintenance of precise elastic properties are not an issue for these instruments.

The Torsion Balance & Scale Co. was formed in 1882 by Dr. Frederick Roeder and Alfred Springer of Cincinnati, Ohio, based, it appears, on a flow of theoretical ideas from Roeder, combined with the practicality and business acumen of Springer.

Roeder had envisaged the beam soldered onto a taut wire or ribbon, so that after the beam had

tipped (twisting the wire slightly) the wire would return to its flat horizontal position. In 1882 he patented (jointly with Springer) his first attempts, a flimsy construction of braced tubes bound with wire. He used parallel beams top and bottom (as employed on roberval scales) and converted the legs down the ends to rectangles made of crossed tubes to brace his taut wires. The beam was merely a tube soldered to the wires. The pan-holders were thin circles of wire soldered to the end rectangles. He used two curved leaf-springs as arrestments that could be raised under the end rectangles. The whole construction looks most unpromising, likely to wobble and prone to collapse.

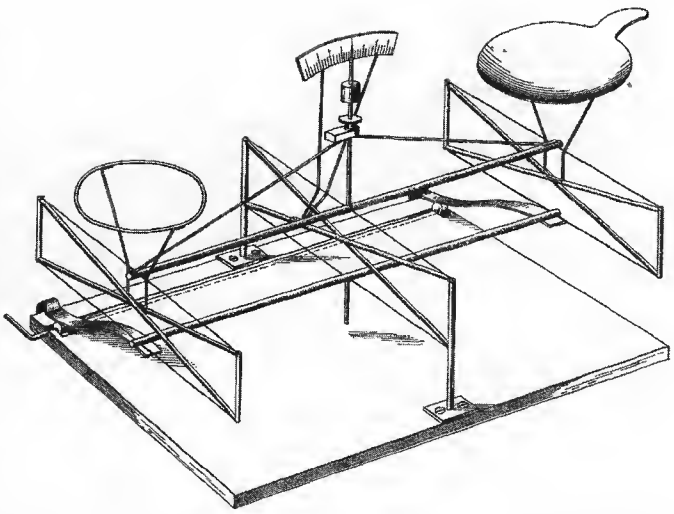
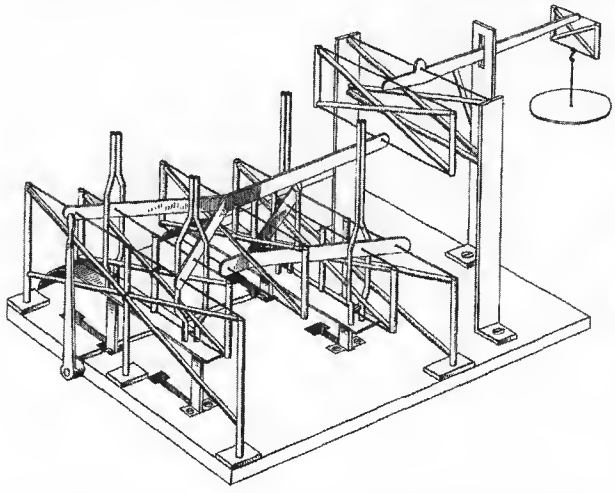


Fig. 1. ⅄⅄ Roeder's first patent, No. 262905 of 1882, for a top-pan counter scale.

The impracticality of Roeder's idea of a good top-pan counter scales was surpassed by his design for *platform scales for weighing heavy bodies*, based on the same principles, and even more wispy! See Fig. 2 & 2a. How Springer had faith in his partner's ideas is hard to explain. Did Springer build one and find it satisfactory? Roeder did include arrestment and a simple damping device made of a leaf-spring below the steelyard but a load bears directly on the first wire without any reduction by leverage. One has visions of wires pinging all over the place!



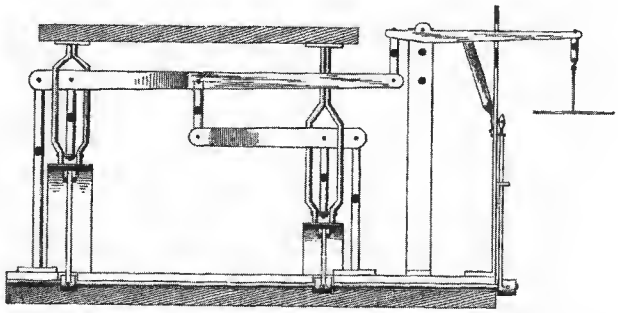


Fig. 2. ⅄⅄ Roeder's platform scales, No. 262906 of 1882, shown in side view.

Fig. 2a. ≺≺ Roeder's platform scales, No. 262906 of 1882, with the platform removed. He has used the Y V pattern.

Roeder was determined to cover the range of scales, his third 1882 patent being for an analytical balance in a case, for *weighing minute quantities of matter*. See Fig. 3. This fragile beam, with its curious trusses at the ends, looks almost practical, and if one were to predict which balance was going to make Springer's fortune, this is the one the authors would select! How wrong we would be! Those readers familiar with analytical balances of the 1880s will note that Roeder did not build-in any means of adjusting the relative positions of the parts of the balance, which must have

worried scientists who required the utmost accuracy in their equipment.

In 1885, the partners were still struggling to overcome the disadvantages in their system with a new.patent See Fig. 4. The partners attempted to overcome inertia by having a sliding high poise (balancing ball) to "topple" the beam, accentuated by a tube of liquid attached to the beam that "sloshed" when the beam tipped, adding extra weight to the lower end of the beam. This implies that the wires were not as taut as they desired.

Springer had his one independent idea in 1884/5. The "Torsional Balance and Scale Co." was still making the trusses out of crossed wires, with the pans soldered to the end trusses. Springer added extra pivots to keep the pan horizontal. The resulting fixture looks very amateurish, but things were to change. See Fig. 5.

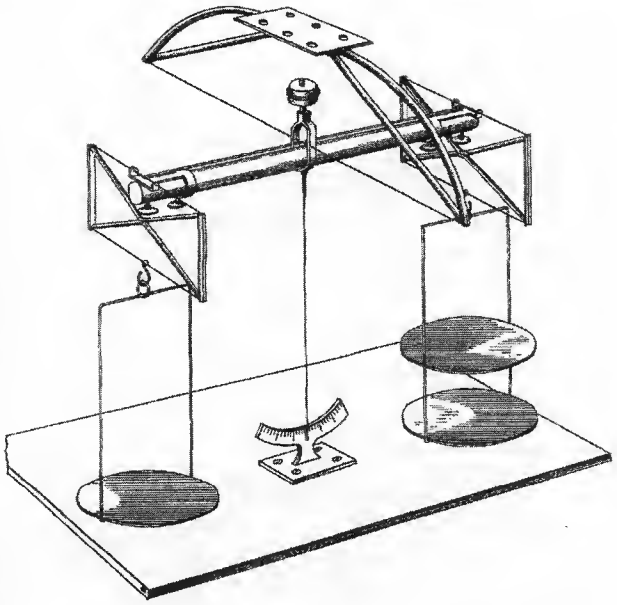


Fig. 3. ⩓⩓ Roeder's patent No. 262907 of 1882 for an analytical balance in a case. The whole device hung from the roof of the case.

By 1889, William Kent patented a much more reliable truss for the torsion wire's support. The wires could be applied tightly on the heavier cast trusses by hammering the truss after the wire was slipped on, thus enlarging the truss. See Fig. 6. By 1891 Alfred Fries was showing (in his patent-drawings) a torsion balance that any owner of a torsion balance would recognise. See Fig. 7. The balance ball was firmly attached to the bottom beam, giving potential to adjust the sensitivity of the beam, and the whole balance was safely enclosed in a glass case with seals to prevent any part of the load getting inside the case accidentally.

By 1916 Clarence Michalis had patented a sliding bar along the front of the scales, *for quick and fine adjustments* assigning the patent to the Torsion Balance Co. He was able to patent a

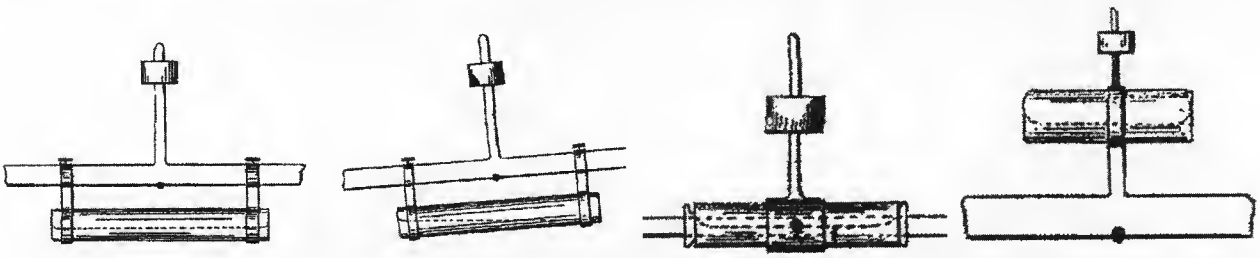


Fig. 4. ⩓⩓ Springer & Roeder's patent No. 310471 of 1885, for a tube containing mercury or some other liquid to be mounted below, round or above the beam.

conventional tare bar by adding a screw thread and releasable nut to enable *a series of rapidly repeated adjustments to be made*, by moving the whole bar horizontally. These bars could be used to tare a container, or they could be designed to move a tiny poise along, giving the smallest graduations of weight clearly and quickly. Such bars were not permitted in Britain on scales for

trade use, but were used on balances in laboratories or factories where inspectors were not responsible.

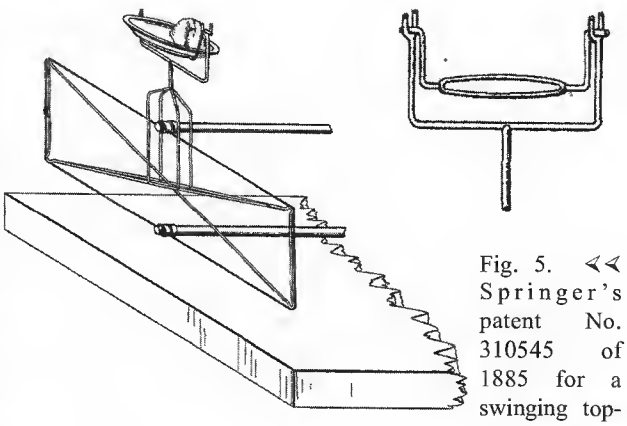


Fig. 5. ≺≺ Springer's patent No. 310545 of 1885 for a swinging top-pan.

George Conway also assigned his 1916 patent to the Torsion Balance Co., and one guesses that both Michalis and Conway were employees. His patent made it possible to alter the position of the center truss in relation to the end trusses, by use of screws in a block. This feature must have been greatly appreciated by scientists and inspectors. The patent drawing shows the improved end trusses, cast with a rising extension to which the pan could be attached firmly.

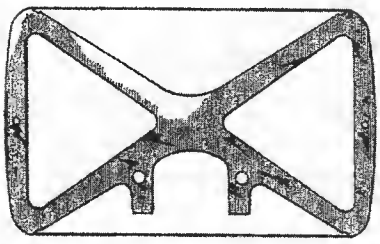


Fig. 6. ⋏⋏ Kent's patent No. 396497 of 1889 assigned to the Torsion Balance Co. for a truss. If for light work, it could be made of sheet metal, temporarily curved slightly and the wire snapped on.

Manufacturer's claims of *Advantages of Torsion Balances:*

(i) **rapidity on accurate work**

This may be justified at least for specific purposes though it is not clear that there would be much more speed over, for example, competing precision beam scales with damping.

(ii) **can carry loads that would destroy knife edges**

This claim can only be proved by a prolonged comparison test, over a period in which knives would wear to the point where they needed replacement. At that point, torsion wires might well still be in good condition.

(iii) **more accurate and sensitive especially under heavy loads**

It all depends what they mean by "heavy". Certainly, under loads below 15-lbs, their claim is justified. But robervals could take a much heavier load, 120-lbs being well within the capacity of some robervals of the same date.

(iv) **much more durable**

There seems to be little that is sadder than an aging torsion balance with sagging wires and broken bands! But we cannot evaluate the distress given to the balance during its working life!

The Torsion Balance catalogue of 1922 gives added information. The striking point is that the highest capacity is only 15-lbs with sensitiveness of 15 grains. This low capacity is most interesting, given the claims in the earlier patents for *heavy weighing*. In Britain counter machines of 14-lbs capacity had to have sensitiveness of 130 grains to pass the inspector in 1907, so the Torsion Balances were, as claimed, considerably more with sensitive at those capacities than counter machines with knife-bearings.

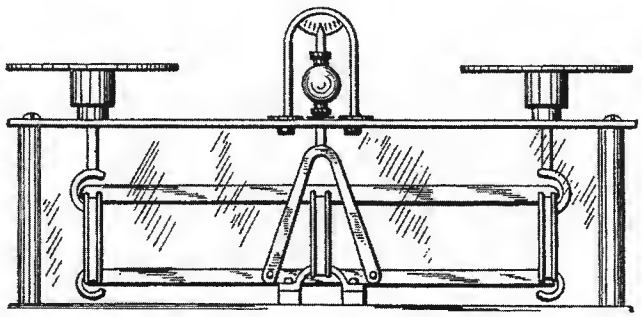


Fig. 7. ➢➢ Fries' patent No. 452371 of 1891, for the grommets that circled the legs and for skirts at the bottom of the pans to prevent anything getting inside the case.

Price comparisons are interesting. to weigh 10 lbs

Fig. 8a. ➢➢ Michalis' patent No. 1167584 of 1916 for a tare bar provided with a screw thread, and a releasable nut carried by the beam and engaging the screw thread for effecting quick and fine adjustments.

in a laboratory using a torsion balance, a scale costing only $50 (approximately £6..0..0) was needed, but using an equal-arm beam (as permitted in Britain) to get a similarly accurate result, the scale cost about £12..14..0. To weigh 5-lbs of confectionery on a torsion balance, a scale costing $25 (£3.0.0) was used, but in Britain a roberval counter scale costing about £4.10.0 was used, and the results were not nearly so accurate!

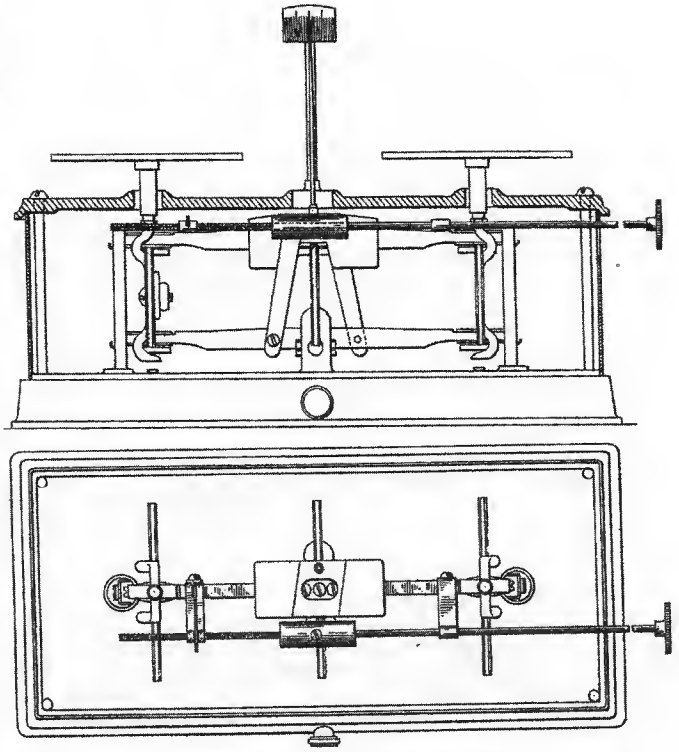


Fig. 8b. ⮙⮙ Michalis' patent No. 1167584 of 1916, top view.

In 1966 Torbal (their most recent name) developed an electronic analytical single-pan substitution balance. It had 160gms capacity and they claimed, had all the advantages of other torsion balances; speed, accuracy and high sensitivity. It had an oil damper, but no beam arrestment, as they claimed that it was not necessary to protect a wire in the way it was necessary to protect knife-edges.

The Torsion Balance Co. was not the only company that used the system. Molins Machine Co of London obtained a Board of Trade Certificate for their counter machine to weigh 2oz in 1954, the Torsion Balance Co (Great Britain) Ltd got a Board of Trade certificate for their semi-self-indicating counter machine to weigh 1-lb (covered to look similar to an electronic scale) for factory use in 1963, and got one for their counter machine of 120gms capacity in 1970.

The authors thank John Knights, Ruth Willard and Jan Berning for their assistance in preparing this article.

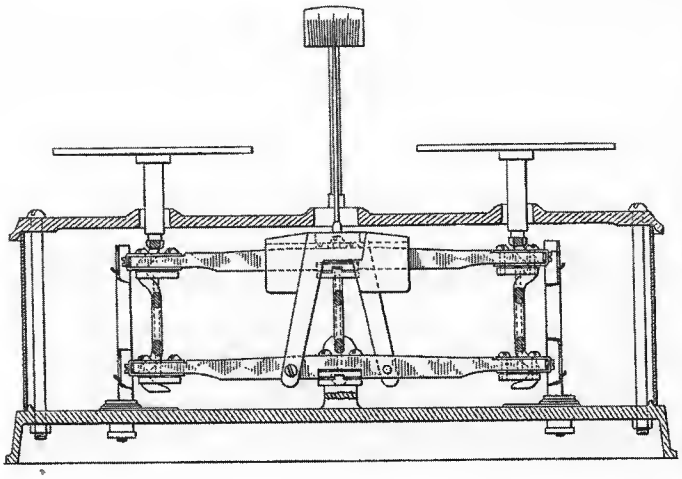


Fig. 9a. ⮜⮜ Conway's patent No 1169929 of 1916. Conway refers to clamps holding the wire on, instead of the earlier solder. He also put clamps to move the end-trusses in relation to the centre. He put clamps to adjust the three trusses to make them precisely parallel. He used clamps to adjust the size of the trusses,to cause the wire to be taut. Yet another clamp adjusted the height of the centre truss.

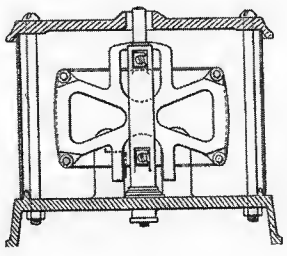
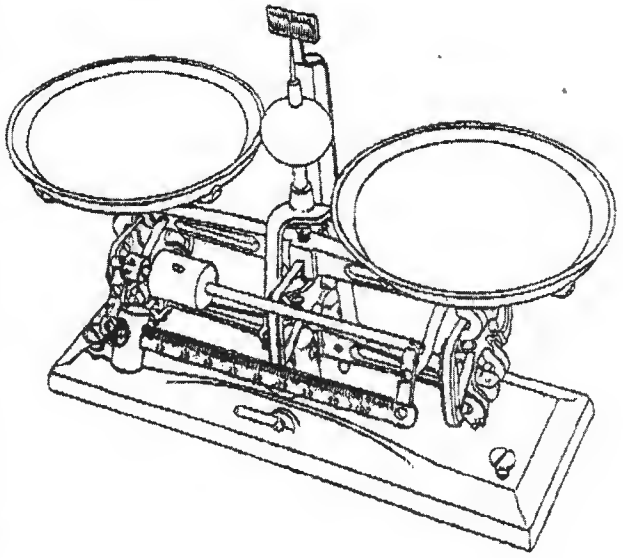


Fig. 9b. ⮜⮜ Conway's patent No 1169929 of 1916, Assigned to the Torsion Balance Co, side view.

Fig. 10. ➢➢ Picture on the Torsion Balance Co. instructions that came with the pharmaceutical balance used by Macy's in 1940. Note the tare bar and the separate graduated beam along the front. Courtesy R H Willard



Editor. The history of the Torsion Balance Co. is in EQM, 996-1003.

Author's Biography

Ross Leadbetter enjoys 600 nondescript scales, collected for their varied interest and principles, rather than their exquisite beauty, over a 30-year period. He has a special interest in Nordic scales (bismars, saddled-steelyards etc) and associated pre-metric weight systems. His wife, Winsome, supports this venture in spite of its space-demands on their home, is keenly interested in the historical implications of scales, and greatly enjoys the friendships originating at ISASC conventions. In real life Ross is Professor of Statistics at the University of North Carolina.

Napoleon Du Brul's Patents

Six patents, numbers 299757 to 299762, were taken out by Napoleon Du Brul of Cincinnati on June 3, 1884, all for substantial, heavy-duty scales that had *flat torsion bars or plates set edge up*. Because he was using bars rather than wires, he did not have problems with trusses; instead he clamped the bar with a block screwed through the torsion bar to the frame. He did suggest conventional knife bearings for the

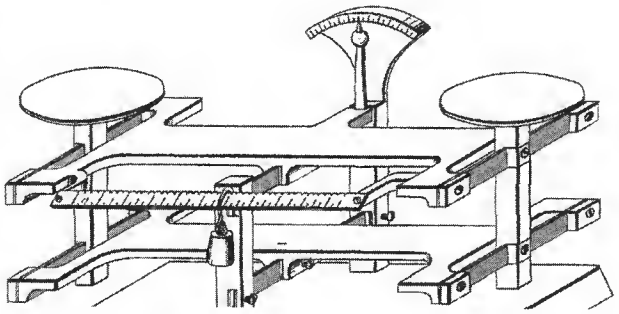


Fig. 1. ⩚⩚ This delightful top-pan counter scale is described by Du Brul as "*simple in design, of few parts, not costly in production, very durable, owing to substantial construction, is of great sensitiveness, and not liable to get out of order*".

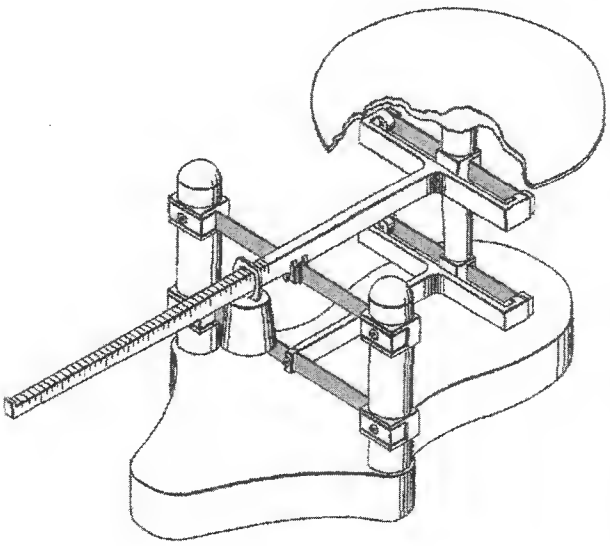


Fig. 2. ⩤⩤ Du Brul seemed not to know the term "steelyard". He describes his beam "*extending in both directions, one end of the beam supporting a pan for the articles to be weighed, and the other end being graduated for a sliding weight... Each beam terminates on the pan side of the machine in a T-head or cross bar, to whose outturned lips are fastened , by clamping block and screw, the ends of two stretched torsion strips. To these strips, at their mid-lengths, is directly and rigidly fastened the pan-support of the pan.*

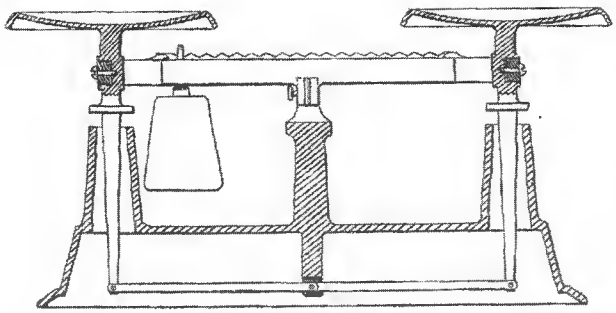


Fig. 3. ⅄⅄ Du Brul's third patent of 1884 relates to this roberval prescription scale, with sliding poisc on a bar at the front. The pans are the classic concave design with sloping sides, much favoured by pharmacists. Note the skirts/stops below the pans to prevent dirt getting into the mechanism. The Torsion Balance Co. did not patent that idea until 1891.

a wide brace, so that the torsion bars are clamped firmly to each side of the bearing, which is under the centre of the pan. Why not put 2 bearings under the pan, one towards each end of the torsion bar? That would have pro-vided a more rigid support for the pan, but per-haps this design was only intended for postal use.

center fulcrum, as an alternative to the centre torsion bar.

His design for a roberval-type counter machine had all the disadvantages of a roberval rotating about its centre-point. He put a bar (or bars) along the front to take small poises.

Fig. 4 shows the beam divides under the pan with

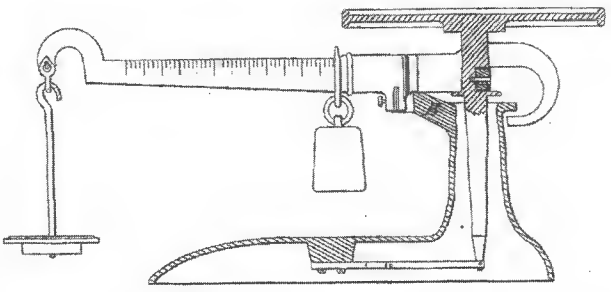


Fig. 4. ⅄⅄ This half-torsion and steelyard is intended for heavier duty than the one shown in Fig. 2. It uses proportional weights on the hanger plus fine weighing with the poise on the beam. Note the hooked stop on the bifurcated beam.

Du Brul never mentioned the use to which his scales were to be put, but the drawings clearly show scales for various purposes, and each patent relates only to the use of torsion bars for the type of scales drawn!

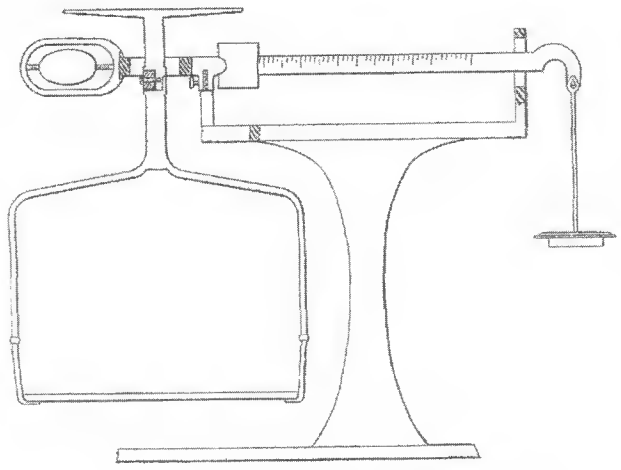
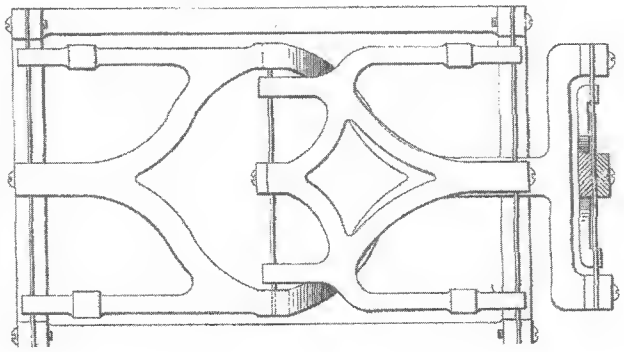


Fig. 5. ⅄⅄ Du Brul's fifth patent for a steelyard with a truly unusual hanging pan which acted on Schickert's principle, forming a mass below the beam to keep horizontal the pan above the beam! Proportional weights go on the hanger. Did Du Brul envisage the user weighing small amounts on the top pan, using the sliding poise, and heavier loads on the bottom pan, using both weights and the poise?

He came from Cincinnati, as did Dr. Frederick Roeder and Alfred Springer of the Torsion Balance Co. Did he hear their discussions and come up with his own solutions? Can any reader say whether they were manufactured?

Fig. 6. ⅄⅄ Top view of Du Brul's very flat platform scale. He suggests connecting the levers *to any usual construction*.



ISASC

EQUILIBRIUM®

QUARTERLY MAGAZINE OF THE INTERNATIONAL SOCIETY OF ANTIQUE SCALE COLLECTORS

2001– ISSUE NO.4 25TH ANIVERSARY ISSUE PAGES 2617-2644

ISASC's 25th Anniversary

For twenty-five years ISASC has provided a supportive community in which people who share an interest in scales and weights can enhance the pleasures of collecting through exchanging experiences, answering questions, sharing information - and sometimes scales - with one another by means of a membership directory, correspondence and get-togethers. At first we each contributed a monthly article on something that interested us and copied it to all members. We gradually developed a vocabulary that we all use without fear of misunderstanding.

In 1978, we started Equilibrium quarterly and a newsletter, a bulletin containing news of the society's activities and other matters of interest; annual conventions with lectures, demonstrations, an auction, sales tables, reproductions of old scale catalogs and books, a video, and a research service.

Members have published numerous books and monographs, participated in academic conferences, and contributed articles to scholarly journals in several languages and several countries. Others utilize their scales in teaching high school physics or speaking to community groups. Albums of members' photographs have grown into a valuable archive. Museums, law-enforcement agencies and auction-houses consult our members for their specialized knowledge. Who would have imagined, 25 years ago, that such a rich experience would follow from a little group of eccentric scale collectors? R H W

Cover Picture: See Tiffany Letter Scales, page 2630..

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Diamond Scales, Part 1

BY C SAIT

How about this for advice on how to start a business? Send your staff to the local beach to get your raw material - pebbles. Sort them using some basic and cheap equipment. Machine them with smaller pebbles, string them together and sell them to agents. Because of their business acumen throughout the world, these agents then sell the pebbles to the very rich people who not only have plenty of money to spend on something that is different but also pay the asking price because there is no competition. Then overnight the market-place doubles in size.

Fig. 1. Diamond scale by John Snart, made between 1707 and 1714, whilst Queen Anne was using "Semper Eadem" as her motto. Shown full size. Carat weights for 32, 16, 8 and 4 carats missing. Weights for 2 and 1 carat survive. "Over against" meant opposite or facing Goldsmiths Hall. The tweezers slide horizontally into the slot at the front right-hand corner. English boxes and scales in this style survive from c.1640 but without labels.

Would you believe that this Utopian state existed? Unbelievable as it may seem, the industry still exists today as a billion-pound worldwide money-making business and is expanding exponentially.

Let me explain briefly and simply as possible. Deep inside the earth, carbon, one of the most basic of elements, is subjected to very high pressure and considerable heat. The result is diamond. Volcanic action and erosion results in these very hard stones being washed down to our beach. History tells us that these harder pebbles were collected in India and passed on to the Management for meagre wages, and exploitation was invented.

Simple tools were made to machine the stones and some superstition added to these now-interesting objects. The prettier ones were strung together and made into necklaces - for men.

Up until now there has been one dubious statement. If these pebbles are diamonds and if the diamond is the hardest substance known to man, how did they machine them? Anything in the world that tried to cut them would be worn by the diamond.

I am not a betting man but if I were, I would lay money on the next paragraph's being true.

One day someone clouted one of these pebbles and found that it broke, resulting in a face showing a clear transparent inside, as opposed to the milky white lump of basic stone. They had discovered the true property of diamond: not only a hard stone but a beautiful one too. Experiments, I suggest,

followed and it was found that other facets could result from this cleaving but only in certain planes. It was impossible to chip anything off in other directions, no matter how hard they hit the thing. However, by using the small dust-like chippings on a circular metal plate, rotating on a spindle, it was found that these 'hard-to-chip' faces could be ground to as beautiful a finish as the cleaved ones, which resulted in the emergence of the diamond as a jewel.

If my hypothesis is proved to be wrong, I apologise, but as evidence, I submit there has to be a good reason why today there are lapping machines with lapping paste, cast-iron plates, dops, tongs and scaifes used in one of the oldest-known methods of machining there is.

Many stories are told about these earliest forays into the diamond trade. The one I like best is when the soldiers of the conquering army of Alexander the Great reached India in 350 BC they came upon the Valley of Diamonds. The entrance to the valley was guarded by snakes whose gaze could kill a man. No problem to Alexander. He issued his troops with mirrors that were turned towards the snakes so that when they looked at themselves they perished. The tale goes on to explain how the diamonds were retrieved but that is rather far-fetched. Professor Tolanski of London University, Fellow of the Royal Society and eminent authority on diamonds was sure that the story was used by those in the know to keep the source of the diamonds a secret. Diamonds by this time had value.

One story that can be confirmed as true is that one of the most satisfactory ways of ascertaining the value of these gems was by weight. Others such as cut, colour and clarity were to achieve importance later.

A simple hand-held balance had evolved. SeeFig. 2. It was easy to put a diamond in one pan but what was put in the other? To answer this the dealers turned to nature. Growing in the warm climate of the Middle East is a tree called the locust tree. It was found that the seed of the locust pod, the carob, when weighed against the seeds from other locust pods all over the vast area of the Middle East, was the same. So by going out into the garden, picking up the shrivelled, brown old banana-like pods, and extracting the seeds, they had a handful of standard weights for one of the most expensive commodities known to man. A weight collector's dream. All that was needed was a name so the standard name for this carob seed became the carat.

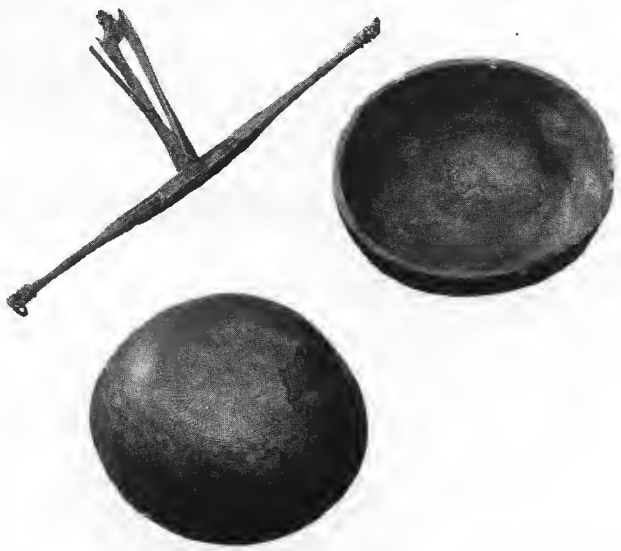


Fig. 2. A fine example of hand-held coin-scales with folding beam, found in almost perfect condition in the wet excavation at No. 1 Poultry, London, currently on show at the Museum of London. The thick bronze pans are too heavy to be suitable for weighing diamonds even though they are high-sided, in the conventional style for weighing diamonds. Roman coins were found with the scales, dating the scales to the early years of the Roman occupation, c.200AD.

Reference to a world map shows that getting the diamonds in this early days from India to the Middle East wasn't such a bad idea. Palestine was right at the centre of a lot of trading activity: the hub with spokes going to Africa, Europe and Asia. This meant that possibly the best-known

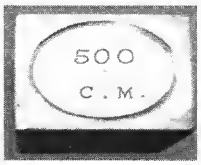
salesmen in the world were going into all the important countries to set up agencies. There were family-run businesses in Amsterdam, Antwerp, Paris, London and many other places that became the flourishing centres for diamond-selling, to a ready market of royalty, famous and rich people, looking for an outlet for their wealth.

So we have the product which was found on the beach, the simple ability to make it saleable, the marketing and selling organisation and, to ensure fair-play, the reliable method of weighing but what about the market doubling overnight?

The chauvinist would argue that it was right that such expensive and beautiful objects of jewellery should only be used by men. If that is what turns you on then this is true. It took Agnes Sorel to change that. According to tradition she was rather friendly with Charles VII of France. She borrowed as many diamonds as she could from past boyfriends, and had them made up into a necklace. What a sensation! She caught the King's eye and the rest resulted in the diamond becoming the girl's best friend. From the dreary world of business the market in diamonds was set to more than double. It exploded. New sources of supply were needed and were found in other areas of the world.

It was all very well for the traders to walk about with small carob seeds in their pockets but what about the growing market of discerning customers who did not want to see their diamonds being weighed with seeds which were taken from a pocket all gummed up with half-eaten sweets? Something more stable and permanent was needed. The metal weight was born. See Fig. 3.

Fig. 3. This shows the interesting tapered shape of carat weights, the one on the left for 500 carats, and the one on the right for 500 carat-metrique. They needed this large weight in diamond-houses for both jewel- and industrial-types of diamonds.



Brought together with, by now, a well-made balance and you would be forgiven for thinking that weighing had come into the new age with flying colours, but no - it wasn't accurate!

It soon became apparent that the carob seed was not as accurate as originally thought. London standard at 205.40mg per carat was obviously different to Florence's at 196.5mg per carat. Again, Madras's at 205.5mg against Brazil's weighing in with a figure of 102.2mg per carat. See Fig. 4.

Fig. 4. Local Weights of Old Carats before Standardisation of the Metric Carat

Alexandria	191.7mg	Constantinople	205.5	Madras	205.5
Amsterdam	205.1	East Indies	196.9-205.5	Persia	213.5
Antwerp	205.3	Florence	196.5	Russia	205.1
Arabia	194.4	France	205-205.5	Spain	199.9
Austria-Hungary	206.1	Frankfurt	205.8	Turin	213.5
Berlin	205.5	Hamburg	205.8	Venice	207.0
Bologna	188.5	Lisbon	205.8	Vienna	206.1
Brazil	192.2	London	205.3-205-5		

Now there was a problem. With improved communication and travel, international trade needed something better. Weighing with natural things was not restricted to diamond-weighing. We have

the grain as the basis of Britain's weighing. Spare a sympathetic thought for those who deal in cochineal. 1 pound equals 70,000 insects. Now there's a job for the new boy.

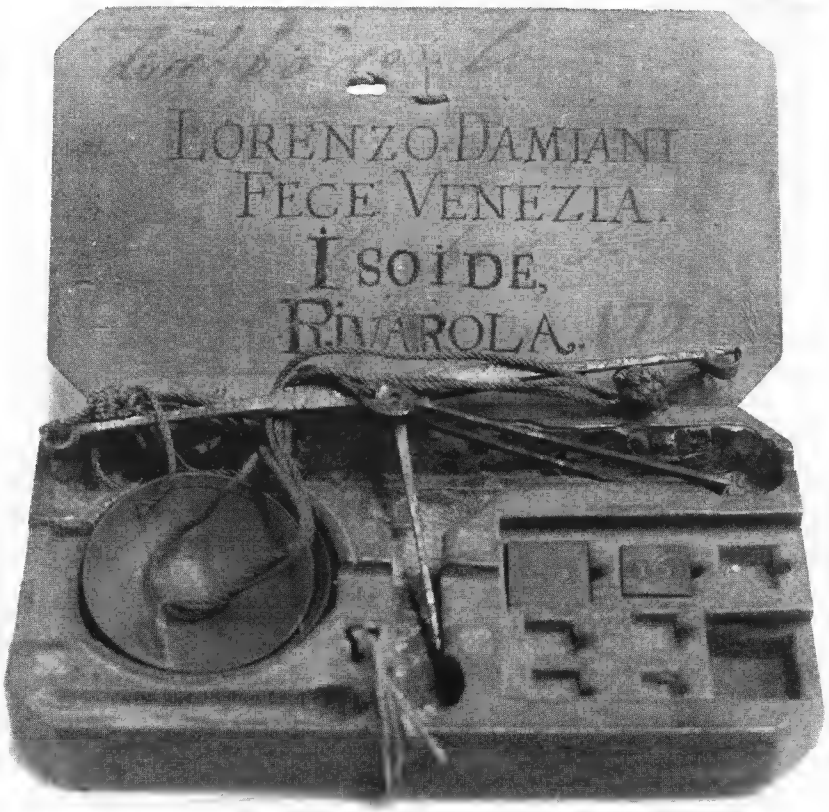
It was an ideal task for the standardisation Committee that met in Paris at the beginning of the 20th century. Delegates arrived at a good standard of 200mg per carat and it was to be known as the carat-metrique (C.M.). Now they had to get countries to agree to it, bearing in mind that there would be gainers and losers. All easy to understand but the importance of the decision faded into insignificance compared with other events that were happening in the world from 1914 to 1918.
Part 2 will be in the next issue.

Author's Biography

Charles Sait admits to having had three ambitions in his life; to be an eccentric, a late developer and cantankerous. He leaves others to be the judge of his success. Professionally, in the early days of semi-conductor technology he experimented with diamond tools and later he went on to sell them. The only diamonds he has ever owned were two 1.5 carat ones given to him during the preparation of these articles by a very helpful person, Fred Murcott, who has worked in the industry all his life. They appeared from a lump of boart Fred was working on and are worth about 75p each. The decision to write about diamonds came one day when sitting at a large dinner event. Opposite was a charming elegant French lady who had her fist wedged in her champagne glass. In his immaculate schoolboy French he asked, "What on earth are you doing, and do you need any help?" She assured him that she was only cleaning the very large diamond in her ring. He regrets having to leave out so much that was gleaned from the many good-natured and helpful contacts to whom he has talked. He is extremely grateful to them all.

Italian Diamond Scale

This diamond scale was made in the 1720s by Lorenzo Damiani of Venice. The similarity with the English set on page 2619 is striking. The weights were originally 32, 16, 8, 4, 2, 1 and 1/2 carats, plus fractional weights. The wooden sliding-lid that should cover all the carat weights is missing. At the front left edge there was once a small brass knobbed poker used to lever out the weights without damaging them. The tweezers/ shovel, that originally lay across the pans and the sliding lid, is missing. Note the long shears and the silk balls at the top of the cords.



Courtesy Science Museum, London

Blowpipe-Set Balances

BY J M SHANNON, G C SHANNON and U BURCHARD

"Blowpipe?" Oh! I know! A bagpipe from Scotland! No?! Maybe a "dart" gun used by native tribes in the jungles? No? But that's what I get when I enter "blowpipe" as a search on the internet! So what is a blowpipe, what is blowpiping and why does that process call for the use of a balance?

Blowpiping

To describe it in the most basic way, the art of blowpiping involves blowing through a small-diameter curved tube to produce a tiny rush of air. This concentrated air is directed through the flame of a candle or alcohol burner, producing a jet of super-heated flame that is directed onto a mineral sample about the size of a pepper seed. Although the process was at first used simply to melt metals and glass, it eventually evolved into a test for metals. The blowpipe specialist found that by adding various fluxes and/or reagents, and fusing the sample in the blowpipe flame, certain conclusions could be formed. By studying the resulting color of the flame, the fused sample, or the oxide coating on the fused sample, most metals could be identified by this qualitative test. The addition of a small portable balance[1] to the blowpipe set allowed the user to perform a quantitative test (determining the quantity of a mineral in a given sample of ore).[2]

Evolution and Development

There is much evidence of larger cased assay balances (but not small portable blowpipe balances) in use through the writings of Thomas Norton (c.1477), Vannoccio Biringuccio of Sienna, Italy (1480-c.1539), Georgius Agricola of Glaucau, Saxony, Germany (1494-1555), Lazarus Ercker of Annaberg, Germany (c.1580-1594), Johann Andreas Cramer (1710-1777) and others. It was the Swedish chemist J J Berzelius (1779-1848), however, who demonstrated that it was more convenient to work with small quantities. The kits ultimately developed for this use included an accurate portable assay balance which used a knife-and-plane bearing system of suspension and a ratchet arrangement for raising and lowering the beam.[3]

Early examples of blowpipe balances were described in 1790 by J F A Göttling (1755-1809), a pharmacist and chemist from Jena (Germany) in his *Vollstandiges Chemisches Probir-Cabinet.* A cabinet consisted of two wooden boxes, one of which housed a small balance.

Eduard Harkort (1797-1835) of Freiberg favored a wooden case (12 by 27 by 38 cm) in which all his utensils were stored in fitted leather-lined depressions. He introduced the special implements for quantitative analysis. The most important characteristics of his kit were the silver assay scale, the cupel mold with three hollow hemispheres,[4] and his balance which was hung on the lamp holder. The balance beam was adjustable in height by means of a silk thread and pulley arrangement. (See fig 1.) This type of construction has been used since the Middle Ages.

(The above-mentioned silver-assay scale should not be confused with the portable blowpipe balance. This scale was made of ivory and closely resembled a narrow 6-inch straight-edge. "It was founded on the principle that the weights of the metallic spheres resulting from the blowpipe test are proportional to the cubes of their diameters, and that these diameters can be accurately compared together by means of two fine convergent lines, between which the spheres are laid."[1])

Perhaps the best example of a blowpipe balance and certainly the most wide-spread in its availability and its use was the one developed by Karl Friedreich Plattner (1800-1858) and William Friedrich Lingke (1784-1867).

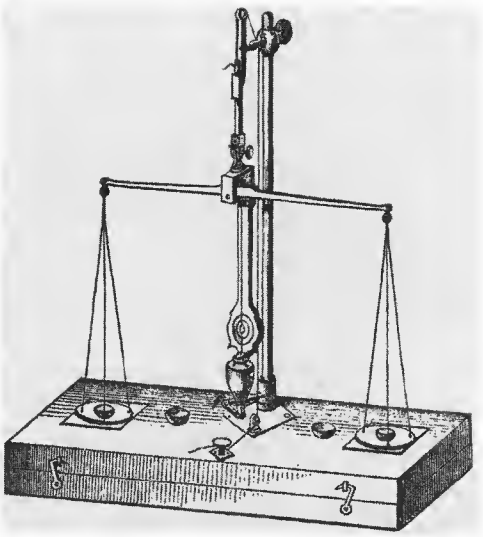


Fig. 1 ⅄⅄ Plattner/Lingke balance with a sensitivity to 0.1 milligrams.

Plattner was born in Klein Waltersdorf near Freiberg, Germany. After studies in high school and at the Mining Academy in Freiberg, the twenty year-old Plattner began employment at the smelter, where he rapidly advanced from a helper to chief assayer. Plattner expanded on ideas he had learned and invented a new procedure for quantitative blowpipe analysis for gold, copper, lead, tin and (at a later stage) for nickel, cobalt and bismuth. His main book, *Die Probirkunst mit dem Löthrohre* (1835), is the culmination of all the knowledge in this field and is generally regarded as the "Bible" of blowpipe analysis.

Although evidence is lost, it can be assumed that Plattner closely cooperated with Lingke, who was the Freiberg "mine mechanicus" and founder of the precision mechanical firm bearing the same name. Lingke developed the Plattner Apparatus, a portable laboratory which was unsurpassed in its completeness and elegant workmanship.

The Plattner/Lingke bowpipe balance is described as follows:

"A Delicate Balance. For quantitative assays this must be capable of indicating with precision an additional 0.1millim.[sic] when loaded with two dg, [0.2g] and should be so made that it can be easily set up and taken apart. Fig. 32 [see fig. 1] is a perspective view of such a balance, as constructed by A Lingke (son of W F Lingke) for blowpipe assays. The beam, which is 180mm long, moves on carnelian plates, and all of the brass work is gilded. The tongue from a to b is 100mm long, and the cords, including the hooks, 140mm. The scale-pans attached to the cords are 33mm in diameter, and very slightly concave, and on each of them stands a small gilt pan 15mm wide and four mm deep, to receive the objects to be weighed and the weights. The two larger pans, g, g, each 20mm in diameter, are used for weighing bulky substances. The balance is set up on a low box, inside of which it can be packed, together with other instruments, when taken apart. On the lid of the box is screwed a stout upright brass rod, to which the balance is secured by a screw, and the beam is raised by a fine silk cord which passes over three pulleys, c, d, e, the lowest one, e, being separately screwed in. This cord is attached at one end to the support of the beam, and at the other end to a knob, which is fastened in the box, and can be turned so as to wind up the cord. The brush, f, fastened on a movable brass arm, serves to prevent unnecessary swinging of the tongue. When the balance is to be used for determining the specific gravity of minerals, metallurgical products, etc, the necessary pans can be.

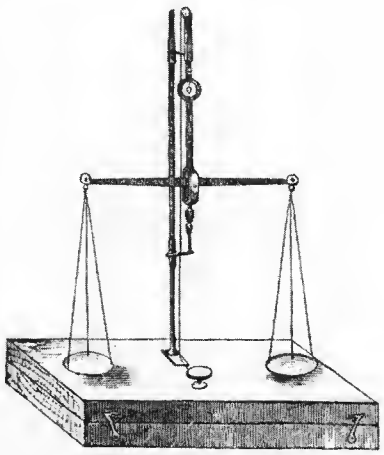


Fig. 2 ⅄⅄ Kern & Sohn drawing from catalog dated at 1874.

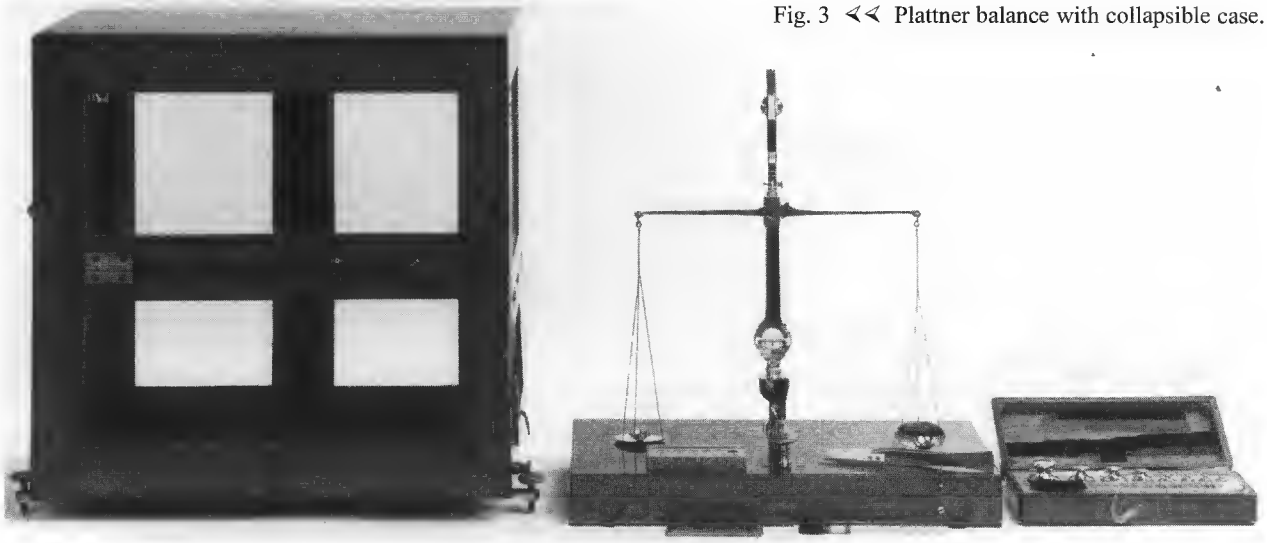


Fig. 3 ≺≺ Plattner balance with collapsible case.

made for it. It is very advantageous to protect the balance against dust and currents of air by a glass case." Lingke has constructed one for this purpose, which can be folded up and transported on a journey

Development of the Industry

Lingke dominated the market for variously sized blowpipe kits from about 1840 to 1880. Plattner Cabinets, undoubtedly manufactured by Lingke, were sold by companies such as J Griffin & Son, London for £24 in 1866.

Gottleib Kern & Sohn, Onstmettingen, Germany, sold assay balances after Plattner in a polished wooden case for 37.70 marks, as well as one in a glass protecting case for 107 marks. Pixii Co. of Paris, France, also made (c.1830) a blowpipe set which included a portable balance.

In 1878 the company of John Teague Letcher (1851-?), in partnership with his brother Thomas Henry Letcher (1836-?), was founded in Truro, Cornwall, and was later renamed Letcher & Sons, Turnpike, Holborn, London. Letcher designed a blowpipe set similar to the Plattner Apparatus in that a leather case contained a wooden box in which all implements for quantitative analysis, with an assay scale and a comprehensive selection of reagents, were housed. E T Newton of Camborne, Cornwall, also manufactured a similar blowpipe kit but of better quality and workmanship than Letcher's design.

Fig. 4 ⩓⩓ A Freiberg-type apparatus case.

Culminating the development of blowpipe kits toward the middle of the 19th Century, Plattner developed his Plattner or Freiberg Apparatus. This apparatus, constructed by Lingke, was conceived as a complete and self-sufficient traveling laboratory. The entire apparatus is contained in a sturdy leather case with four compartments, three for individual boxes and

one for the collapsible glass case of the field balance. All tools, utensils, fuels, sample supports and the analytical balance are accommodated in one wooden box.

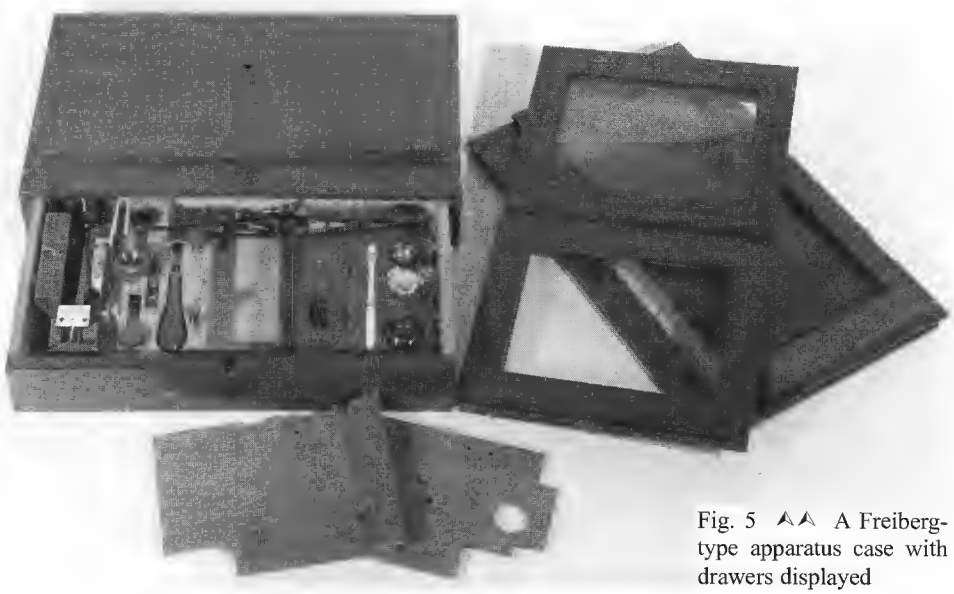


Fig. 5 ⩓⩓ A Freiberg-type apparatus case with drawers displayed

Available American catalog records between the late 1800s and early 1900s show that there were a number of chemical and scientific instrument supply-houses that imported the Plattner blowpipe balance. Table 2 is by no means comprehensive and is based solely on catalogs available to the authors. However, this list does show the widespread use of blowpiping and especially the utilization of the Plattner blowpipe balance:

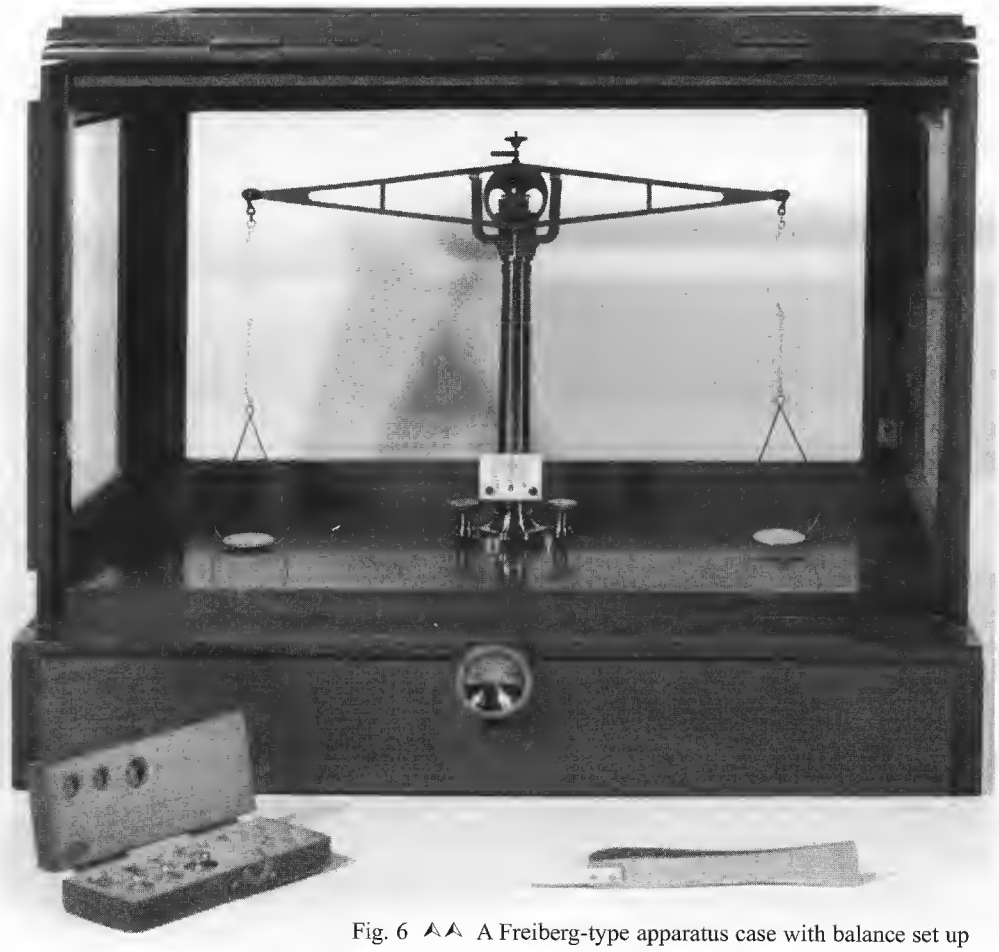


Fig. 6 ⩓⩓ A Freiberg-type apparatus case with balance set up

Downturn of Interest in Blowpiping

The process of blowpiping began to fall out of favor in the middle to late 1800s. This is evidenced by the writings of many scientists of that time, who seemed no longer to emphasize the importance of blow-

piping as an analytical tool. Perhaps some of the more important causes were the invention of the gas burner around 1888 by R W E Bunsen (1811-1899), and in 1912 the discovery by M von Laue (1879 1957) of the diffraction of X-rays passing through a crystal. The latter established the possibility of relating crystal structure to the chemical composition of a mineral. Additionally, the market for and the general availability of full-sized laboratory assay balances, as well as small portable assay balances, had increased to the point that these weighing instruments were readily available and could be found in the most remote locations.

Table 1. Suppliers of Blowpipe Sets

Henry Heil Chemical Co., New York in 1891, 1904
John Taylor & Co., San Francisco, California in 1893
Bullock & Crenshaw, Philadelphia in 1893, 1897, 1899
Justinian Caire, San Francisco, California in 1896
Denver Fire Clay Co., Denver, Colorado in 1898, 1901
Eimer & Amend, New York in 1898, 1910, 1913
Mine Smelter & Supply Co, Salt Lake City, Utah in 1912

Recognizing Blowpipe Balances

Blowpipe balances are rarely found in antique stores or at auction, but because of their rarity, are always worth the search. Although there is some variation in the Plattner/Lingke design, the general style is easily identifiable. (See description of *A Delicate Balance*, above.) On authentic Plattner/Lingke designs a very small distinctive "crossed pick" or "crossed hammer" emblem can sometimes be found on the beam and on some of the containers in the chest. There may also be small squares of white glass plate mounted on the wood base, which serve as the pan arrests.

Table 2. Full Blowpipe Set

blowpipe	magnet	glass matrasses (flasks)
charcoal	streak plate	mortar and pestle (several)
platinum foil	balance w/all the parts	hammer
glass tubes	weights for balance	files (several)
test tubes	collapsible case for balance	magnifying glass
knife	alcohol or oil burner	watch-glasses and porcelain capsules
pliers (several kinds)	platinum wire	as many as 31 dry and liquid chemicals
cupel mold and stand	forceps (several sizes)	

Notes & References

1. Burchard, U, has previously published much of this information in his article "The History and Apparatus of Blowpipe Analysis" printed in the *Mineralogical Record*, Volume 25, No. 4, July-August 1994, 251-277.

2 The process of quantitative analysis can be defined thus: A sample of ore is ground into a homogenous mass and weighed. Then by the introduction of various chemicals and heat, the mass is reduced to a gold (or other metal) button which is weighed. It then becomes a fairly simple mathematical process to extrapolate the amount of gold per some given quantity.

3 Stock, J T, *Development of the Chemical Balance,* London: Her Majesty's Stationery Office 1969, 4.

4 Cupel: a small cup made from bone ash and used in the cupellation part of the process, wherein the oxide of lead is absorbed by the bone ash, leaving a more pure button of metal.

5 Richter, T, trans. Cornwall, H B, *Plattner's Manual of Qualitative and Quantitative Analysis with the Blowpipe,* New York: D Van Nostrand, 1875, 28.

6 Richter, op cit, 26, 27.

Author's Biography

Retired educators and co-authors of the fine monograph *The Assay Balance,* Gerry and John Shannon have recently turned their talents to assisting the editors of EQM. John has served as the Director of the Geological Museum at the Colorado School of Mines and as the first Curator of the National Mining Hall of Fame in Leadville, Colorado.

Small World, Wasn't It?

BY J R KATZ

Henry Troemner started out in this country as a locksmith working on the construction of Girard College in Philadelphia. Toward the end of his employment at Girard, Troemner became acquainted with F Meyers, a scale-maker by trade. (NOTE: The author has never seen any scale bearing the Meyers name.) Their friendship led to the formation of a partnership in April 1840, under the name Meyers & Co, originally at Decatur Street, Philadelphia.

A few years later the partnership dissolved and Troemner moved to Market Street, where he founded the business of HENRY TROEMNER, MANUFACTURER of SCALES & WEIGHTS.

But what happened to F (Frederick) Meyers??

California Coiners and Assayers by Dan Owens gives a listing for Meyer & Company, with reference to his past as *Manufacturers of Scales and Weights of every description at Market Street, Phila.* Further discussions with the author revealed that:

(1) Little is known of this firm, not even its location

(2) The total number of Meyer & Co gold ingots (assay bars) currently known is one

Conclusions and Questions:
The time frame when the Troemner - Meyers partnership dissolved is consistent with the time of the California gold rush. - maybe it was a bit earlier. Was Meyer bitten by the gold bug to try his hand as assayer in California? But why is there so little evidence of him as an assayer? Was it because of his habit of spelling his name four different ways: Meyer(s), Myer(s)?? Who knows, but it was a small world then as it is now.

Notes & Queries

N & Q No 146 FROM L HOLLAND

I am glad you enjoyed Simon Bendall's book, reviewed on EQM 2579-2581, and wholly agree with your high opinion of it. It's really very good. I like the skill with which he gives a semblance of order to a subject which is so full of uncertainties and total blanks; if they were all spelt out in detail, most people would be scared off. At the same time he doesn't try to fill any of the knowledge gaps with invented nonsense, which is a nasty habit of far too many "authorities" on metrological history. His short essay on the weight system is indeed a model for other scholars to follow.

"CONOB" is actually two words. CON stands for Constantinopolis (Byzantium), where most (though by no means all) Byzantine gold coins were struck; it was originally a mint-mark, though it is found on solidi known to have been struck at other mints, such as Rome, Ravenna, Carthage. Why? I doubt if anyone knows. OB stands for OBRYZIACUM (or something like it --- I'm not much of a whiz at Byzantine Greek, or any kind of Greek), meaning "refined gold". The gold of solidi (and of most other ancient gold coins) wasn't alloyed with other metals to make it more resistant to wear, as in modern gold coins; it was as pure as they could make it (unless they debased it deliberately, as in the last centuries of Byzantium). --- Seaby's *Byzantine Coins and Their Values* is an excellent primer for studying that remarkable coinage, and provides a first-rate potted history of Byzantium, too (concentrated, piquant, and easy to digest: a sort of literary "Marmite").

Tiffany

BY B STEIN

Lamps, Yes, But What Else?

To antique collectors or art aficionados, the name Tiffany immediately brings to mind images of lamps, lamps, and more lamps of all kinds - floor, table, desk, and ceiling. Each Tiffany lamp is characterized by mosaic patterns of Favrile glass, Favrile being a term coined by Tiffany to describe a special kind of glass made exclusively from his own formula and used exclusively for his own lamps. In effect, the novel glass served as a most visible and attractive hallmark.

If the public's art perceptions be known, a consumer poll probably would reveal that nine out of ten people would know Tiffany lamps, but few would know about the right to fame in larger measure of the Tiffany name.

This is somewhat shameful, considering that the name of Tiffany Studios, and more pointedly, Louis Comfort Tiffany, was near ubiquitous during the turn-of-the-19th-century when first-rate American artists came center stage. Most certainly the name Tiffany rightfully belongs among them, his talents giving expression to a diverse array of art works throughout his lifetime.

Fig. 1. ⩓⩓ Tiffany letter scale *Grapevine,* metal overlay representing grapevines combined with Favrile glass. Green patina over green opalescent glass.

Fig. 2. ⩓⩓ Tiffany desk set (1889-1928), *Ninth Century*, gilded bronze pattern. Sixteen pieces including blotter ends, large and small letter racks, inkwell, pen tray, calendar frame, thermometer, letter scale, stamp box, letter knife, rocker blotter, note pad holder, paper stake, pen brush, paper clip and magnifying glass.

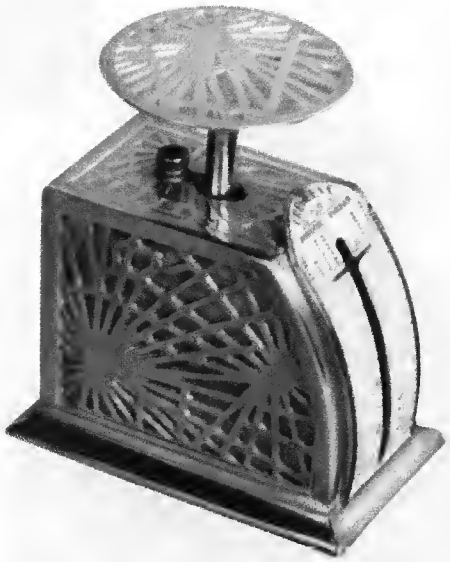


Fig. 3. ≺≺ Tiffany letter scale *Pine Needles*. Metal overlay representing pine boughs combined with Favrile glass. Gold-plated over amber opalescent glass.

Cover picture. Tiffany Studios letter scale. *Chinese* pattern. An adaption of the motifs found in the bronzes of the Chou dynasty.

Fig. 4. ≻≻ Tiffany letter scale *Grapevine*. Silver metal overlay representing grapevines combined with Favrile glass.

Tiffany, the Artist

Louis Comfort Tiffany was born in 1848, the son of Charles Tiffany, founder of Tiffany & Company Jewelers, Fifth Avenue, New York. Louis Comfort's training was as a painter, but he soon came to realize that his forte was decorative art, usually created as three-dimensional objects that most often served a functional as well as decorative purpose. In 1879, his talents were first introduced to the public, initially and ever after finding widespread acceptance as an art form appropriate for display in galleries and museums, and equally if not more so, display and use in homes and offices.

Tiffany, the Artist and Businessman

In 1879, the business to first bear the artist's name was Louis C Tiffany & Company Associated Artists. Successor or affiliate businesses followed, most bearing the Tiffany name: Tiffany Glass Company; Tiffany Glass and Decorating Company; and Allied Arts Company, the last was mainly

Fig. 5. ≺≺ Tiffany letter scale *Zodiac*. Gold with multi-coloured figures, ornamented with primitive designs crudely modeled. Zodiac signs are carved in low relief on medallions formed by interlacing band ornament.

Fig. 6. ≻≻ Tiffany letter scale *Abalone*. Highly finished in soft gold. Discs of natural abalone shell (mother of pearl) embedded in metal.

Fig. 7. ≺≺ Tiffany letter scale *Venetian*. Dull gold finish decorated with richly-chased ornament relieved by a carved band of ermines at base. Style used by Venetian craftsmen making tooled leather objects in the 16th century.

Fig. 8. ➢➢ Tiffany letter scale *Byzantium*. Orna-mented with raised beading and inlaid carnelians.

a furniture manufacturer. Whatever the company name, its line of art products met with public acclaim and flourished through the latter part of the 19th century. In 1900, the name of the company was changed to Tiffany Studios (New York). It operated thus for the next two decades, and as the 20th century began, at the age of 52, Louis Comfort Tiffany found himself standing on the plateau of success, as both a businessman of note, and an artist of international renown. Most assuredly, the company's product line representing Louis Comfort's immense and multi-faceted talents. The line went far beyond lamps, and included furnishings for the entire house. Products included wall coverings, carpeting, tapestries, furniture, glass mosaic for walls and ceilings,

Fig. 9. ⋎⋎ Apollo Studios Letter scale. A Tiffany imitation, part of a three-piece desk set, with poor rendering of grapevine pattern and pseudo Favrile glass. Face missing.

Fig. 10a and 10b. ⋎⋎ Tiffany Furnaces letter scales. Two rare desk accessories: one with mottled gold finish overall and blue enamelled patterned inlay on base; one with mottled gold finish overall and maroon and pink enamel patterned inlay on base.

Fig. 11. ≺≺ Tiffany parcel and letter scales *Pine Needles*. The tall and the small of it.

jewelry, silverware, specialty pieces both decorative and utilitarian, such as vases, jars, vinaigrettes, glassware, globes and shades, monuments and gravestones(!). Most important and enduring, leaded glass windows for churches, public buildings and homes, all featuring Tiffany's elaborate Favrile glass compositions. ("Favrile" we are told, originates from an Old English word "fabrile," meaning homemade, and with the same root as fabricate.)

In 1919, Louis Comfort was about to retire from active company participation, though retaining his title of president. Tiffany Studios underwent major reorganization at that time, and the company continued under new management and a new name: Louis C Tiffany Furnaces, Inc, with financing provided by Tiffany himself. The new company, simply referred to as Tiffany Furnaces and using the name as its signature, began to produce a new line of glass and metalwork, the latter with an elaborate, decorative look. The matter of quality was to become a stumbling block in the immediate years that followed, and in 1928, production ceased when Tiffany Furnaces went out of business.

Today, hardly any of Tiffany's Furnaces works are to be found, and the occasional piece is, indeed, a rarity. Sad to relate that Louis C, though retired, lived to see the demise of Tiffany Furnaces, and he in turn died in 1933 at the age of 85.

Fig. 12. ≺≺ Tiffany letter scale *Bookmark*. Solid bronze, dull gold finish. Note ornamental use of typographical marks of early printers and publishers.

Fig. 13. ≻≻ Tiffany letter scale *Graduate*. Distinguishing feature consists of simplicity in line and decoration. Finished in gold with inlay of soft color tones.

Tiffany Metalwork

Prior to 1900, the Tiffany firm, operating under several different names, produced a broad line of metalwork, usually made by other firms according to Tiffany's specifications. In 1898, Louis Comfort organized his own foundry and metal shop, and began to make his own metalwork, characterized by considerable diversity and individuality.

Most Tiffany metalwork was made of cast bronze or spun shapes from copper sheeting. All items were carefully hand-worked by either chasing or etching, then plated or patinated. Many came in different finishes: silver, gold, brown or green-colors produced according to prescribed Tiffany formulae. The numbering and signing of pieces followed a system, by and large properly maintained, but over the years, enduring occasional failings. Notwithstanding that mild aberration, however, the public's tastes, along with those of the art world, prevailed and Tiffany metalwork enjoyed worldwide and long-time acceptance. In 1899, an exhibition of the Tiffany foundry's products held in London included a wide range of metalwork objects, particularly desk accessories such as inkstands, paperweights, letter-boxes and writing lamps. The awards followed.

Tiffany Desk Sets

From 1900-1920, Tiffany Studios produced and sold matched desk sets made of bronze as part of its line of metalwork. Each item of each set was priced and sold individually. There really never was a basic set, although a minimum of nine pieces was deemed to be so, and was comprised of blotter ends, inkstand or inkwell, pen tray, paper rack, paper knife, rocker blotter, memo pad holder, utility box and perpetual calendar. Numerous other items were made, however, sometimes bringing the number of pieces in a desk set to as many as 25, if the set included a reading or magnifying glass, paperweight, bill file, paper clip, pen brush, pen holder, thermometer, book ends, desk lamp, picture frame, ashtray, match stand, stamp box, and particularly, a letter scale.

Table 1. Tiffany Studios Desk Set Patterns

Pine Needle (2)	Ninth Century (1)	Louis XVI	Grapevine (3)
Venetian (1)	Nautical	Zodiac (3)	Graduate (1)
Heraldic	Bookmark (1)	American Indian	Modeled Design
Byzantine (1)	Chinese	Spanish	Abalone (1)
Adam	Medallion	Royal Copper	

*Parenthetical numbers denote desk sets with one or more letter scales

Desk sets came in 19 patterns created by the artist, and within certain patterns, varied according to color finish - gold, silver, green or brown, and even varied in style on occasion. Prices for individual pieces varied according to piece and pattern. For example; the following prices appeared in Tiffany Studio's 1920 Catalog, in the *Pine Needle* pattern, $3 for a paper knife, $8 for a pen brush, $18 for blotter corners, $25 for a small paper rack, $35 for a lamp, $44 for a lamp in gold, $14 additional for the lamp shade, and $14 for the letter scale. For any piece in *Pine Needle* that was $14, in *Graduate* it was $15; in *Abalone* $18; in *Ninth Century* $20; and in *Venetian* $25. Today, these items, if they can be found at all, cost 25 to 50 times as much, and sometimes much, much more.

Tiffany Letter Scales

Of the 19 desk sets with different patterns made by Tiffany Studios, nine included letter scales. In addition to these nine, Tiffany also made at least five variations of certain patterns, and it is this

total of 14 that comprises the author's collection, to which might be added one or two variations that the author has seen or heard of, but has never been able to acquire. In addition, Tiffany Studios made two large parcel scales (for weighing packages). *Grapevine* (#15), and *Pine Needle* (#25) clearly do not belong in any desk set. Also, a letter scale was in the one desk set produced in several colors by Tiffany Furnaces.

Scale making

In point of fact, Tiffany Studios never laid claim to being a scale maker, per se, and apparently considered the manufacture of "scale works" a specialty better left to others.

This distinction led to Tiffany designing and fabricating only the scale frame, and where appropriate, the Favrile glass underlay. The Studios in turn, bought the metal spring balance mechanism and celluloid bow-front face from a scale maker, in this instance the Chicago-based Pelouze Scale Company. Consequently, each Tiffany letter scale designed for a desk set had a face that not only was calibrated in ounces and postal rates, but also bore the Pelouze name on the bottom and the Pelouze trade name, Crescent, at the top. These markings took nothing away from the Tiffany Studios signature on each desk set piece.

Beware of Imitations

Although a few metalworking firms included scales in their product lines, including Gorham, Heintz, and Jennings Brothers, none seemed inclined to compete directly with Tiffany. An exception seemed to be Apollo Studios of New York City, which during the brief time it was in business (1910-1934), made a three-piece metal desk set, including a letter scale that simulated the Tiffany *Grapevine* pattern overlaid on mottled green glass and bore little, if any, resemblance to the real Favrile. Apollo Studios failed to make its mark, and in a matter of time, seems to have faded away.

Back to Tiffany

From 1879 to 1920, Tiffany as a man and Tiffany as a company flourished and expanded. Louis Comfort employed 200 designers and craftsmen, and the firm sold its art objects through carefully-selected outlets: Tiffany Studios itself, Tiffany and Co. Jewelers, Marshall Fields, Neiman Marcus, Shreve's, and the Salon de L'art Nouveau (Paris), to name a few. The Tiffany name subsequently endured some hard knocks, however and in the middle years of the 20th century, Tiffany fell into disfavor with the art world, facing charges that any works mass-produced in substantial numbers did not warrant artistic recognition. That attitude was bound to change as Tiffany works continued to gain favor, and today, the Tiffany name carries with it an outstanding reputation for fine art, both within and outside the art world. A well deserved honor. Today, Tiffany exhibitions tour the US, and Tiffany art commands impressively high gallery auction prices. Certainly for Tiffany Lamps, but also for so many of the other items that proudly carry the Tiffany name.

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Author's Biography

Bob Stein collected postal scales for many years before he met the Crawforths and together they started a society for the 25 people they knew who also collected scales. Bob used his immense powers of persuasion and his literary fluency. He gave his advertising skills generously, and was a great President for 23 years. His enthusiasm was essential to the success of ISASC, and he was admirably backed up by Margie with her warmth and her calligraphy.

Review

Lead Weights, the David Rogers Collection, by Norman Biggs and Paul Withers, published by White House Publications & Galata, The Old White Lion, Market Street, Llanfyllin, Powys SY22 5BX, price £15.00, plus packing and postage, ISBN 1 8983 10 05 X. 72 pages A4, 290 weights photographed full-size with both sides of weight shown when appropriate.

Eagerly waiting for this book, it was wonderful to receive a book that fulfilled expectations. It has a very condensed text that needs thorough reading, as every word counts. It contains an amazing amount of information to enable the reader to put lead weights in their British context, and to follow up any weights that are particularly interesting. Perhaps the most impressive aspect of the book is the care with which the authors have spelled out what it known, hinted at what is beginning to be understood, and shown where the doubts and the ignorance lie. We have come to expect scholarship and humour from these authors, and this book is as good as any they have written.

The obvious feature is the photography. The angle of view has, in all cases, been chosen to show the designs and the marks on the weights. This is wonderful for flat round weights, except that one cannot compare the "flat weights with concentric circles" with their counterparts made of bronze, which are easily dated approximately by their profile. The top-view leaves one wondering about the profile of many weights. Either a sketch or an angled shot would have been helpful for some of the weights.

Fig. 1. ⩚⩚ A cross pommée, with raised central and terminal projections, and a pellet in each quarter. 70g. 32mm, height 13mm.

The price guide was produced very rapidly, so perhaps it is too much to expect the authors to produce one that relates the *condition* that dictate the market value. The rarity and the parts of the country where the designs appear might usefully be included in a 2nd edition. The reader will know that lead weights do not come onto the market often, and maybe they should all be considered rare weights, until the metal-detectorists find more. The area from which any one design comes must be cautiously approached, as most of the weights on the market arrive without provenance, or maybe a vague *Yorkshire*, or *from the River Thames*.

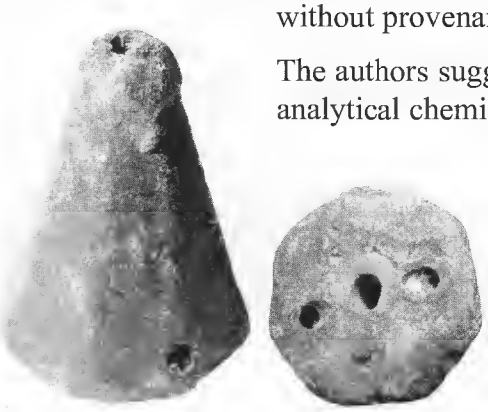


Fig. 2. ⩚⩚ Octagonal pyramid. There is a vertical hole right through the centre, & 2 sloping holes from the base to the outer surface. The holes cast some doubt on the function of this piece. 328g. Height 53mm, diameter of base 40mm.

The authors suggest that oxidation affects the mass, but ISASC member, the analytical chemist B J Oliver, investigated the oxidation on lead weights and came to the conclusion that, once in the soil, a thin layer of oxidation deposits rapidly, and the stabilised weight neither gains nor looses significant mass.

The introductions deal with the fraught problem of identifying a weight, as *a single weight does not necessarily belong to a weight system*. Each chapter has an introduction that is a model of lucidity and thought-provoking facts, as exemplified by that on page 46 for *late Mediaeval coin weights and bullion weights*. The terminology is clearly defined, and graphs have been compiled to demonstrate the weights' accuracy and rarity.

The weights have been classified by physical shape, regardless of mass or unit systems. So all square weights are together, all shield-shaped, all weights with embedded objects, which, given the paucity of these weights, is as good a method of grouping them as is possible. Most collectors use this grouping, so the book gives quick access to the knowledge so far accumulated.

Fig. 3. ⅄⅄ Three lions passant guardant to the right in a border with bezzant above. 204g, 43 x 52mm.

The authors have interposed a few figures. The reader must recognise that these weights do not come from the Rogers collection, and are intended to enrich our understanding. Because the figures are in the introduction to each chapter, they are chronologically out of sequence with the ones in the collection. For example, on page 54, two appetising Elizabeth I weights are shown before the mediaeval weights and crowned **h** weights (Henry VII or Henry VIII's reign).

Figure 4, on page 30, is an anomaly, a standing weight being still used in the 19th century, and provoking curiosity as to its true age. An illustration of a steelyard poise would have been helpful when discussing them, as would an explanation of *heater-shapes* for those too young to remember the blocks of iron heated up and inserted into smoothing irons.

The standing weights are a puzzle. The ones in the Rogers collection consistently show signs of having had, or still having, a hole near the top, whereas the *possible gaming pieces* have never had a hole in them. Is this significant? And why are some holes offset, as on pages 38 and 39? The shield-shaped weights with lions on page 37 have three lions on the larger weights but only one lion on the smaller weights. Is it coincidence? Where does the symbol of two mirror-image lis come from? The authors provoke the questions, but, until more is known, we must be satisfied with observations and discussions. A particular delight was finding that the authors have sorted out the differences between the Charles I and the Charles II marks. The difficulty of differentiating between weights marked by the authorities of monarchs with the same name will remain.

No book on lead weights has been previously written. This book is the first significant book on the subject. We must be thankful that it is such a thorough book, and so superbly illustrated. The enthusiasm of the review tells the readers that this is an excellent book, and worth every penny. If you have lead weights, buy it.

A J C

Review

A Compilation of Canadian Manufacturers and Distributors of Scales and Weighing Machines by R S Traquair, published by ISASC, 2001. 43 pages of text, plus 44 pages of contemporary documents, single sided 11 x 8½ins. Price $20.00.

This book has been compiled solely from trade directories between 1819 and 1940, some excellent long runs and some single volumes that have survived the vagaries of history. Traquair has considered the needs of collectors and researchers, putting the information into many helpful lists with explanatory notes. He has analysed 185 companies as they appear from the Directories and drawn attention to connections. About half of the companies were subsidiaries of companies in

USA or the UK, and naturally Traquair has shown greater enthusiasm for the Canadian companies.

Traquair gave an excellent talk at the ISASC Convention in May 2001 about Canadian inspectors' verification marks, and the relevant Acts and practices, which would have formed a useful chapter in this book. If ever a second edition is published, we must hope that he adds all he knows on W & M inspections.

It would have been helpful if the printing had been done double-sided, to reduce the weight and bulk of the book. The advertisements are immensely illuminating factually, but badly reproduced, one suspects from photocopies of photocopies. The book will be invaluable for collectors of Canadian scales and will be used for many years to come. D F C-H

Canadian Scale

This pendulum counter scale was made by the Brantford Scale Co. Limited, of Brantford, Canada, fifty miles south-west of Toronto. The scoop is brass and the whole scale has a smart gold-enamelled finish. The graduated arc is marked from the right side 4oz, 8oz, 12oz, **1**lb, 4oz, 8oz, 12oz, **2**lb, 4oz, 8oz, 12oz, only. The inspector has used the Canadian method of showing that the scale is verified - a paper 'medallion' with DEPARTMENT OF TRADE & COMMERCE round the circumference, and a GR and crown in the middle. Traquair gives a date of 1914 only for this company, but it probably was the pre-decessor of Brantford Computing Scale Co. Ltd (started 1915) and Brantford Speciality Mfg. Co. Ltd (selling household scales in 1927, and Automatic Computing & Counting Scales in 1930).

X Marks the Patent

BY R HENDRICKS WILLARD

For years, collectors have heard rumors of the X-Patents, but almost no one has succeeded in locating them. The very symbol, "X" denotes a mystery - an unknown quantity in mathematics, or the "mark" of a person who does not know how to write his name. Inquiries at the Patent Office revealed that the designation applies to the approximately 10,000 US Patents issued between April 5, 1790, (when the first patent statute was passed by the Congress and signed into law by President George Washington) and 1836, when nearly every one of those records, drawings, and working models was destroyed in the Patent Office fire.

What a loss! The sheer size of the country demanded new tools and equipment for farming, manufacturing, transportation, and everyday tasks. Those 10,000 inventions were the blueprint, as it were, for America's technology.! It must have taken hundreds of engineers, scientific instrument

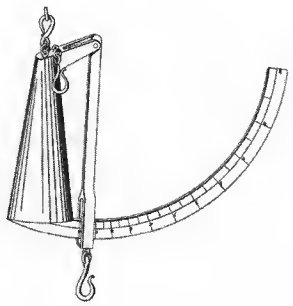


Fig. 1. ➢➢ Phinney's patent 2041X of Jan 6 1814 for the first US pendulum scale. Judging from his description, he thought of this idea independently of European developements. Two suspension hooks allow for two sets of graduations, one for light loads and one for heavy loads.

makers, mechanics, blacksmiths, carpenters, tinkers, and farmers to produce them. Applicants filed a petition including drafts (technical drawings), a written description, and a model of the invention. Applications deemed worthy (by the Secretary of State, the Secretary of War, and the Attorney General, or any two of them), were reviewed as to legality and sent to the President for his personal signature. The patent was then delivered to the patentee. It ran for 14 years and cost four or five dollars, which the patentee paid directly to the clerical workers who had performed the various services. Those early patents, officially known as Name and Date Patents, were not numbered.

That fire was a catastrophe. All patentees were asked to return their patents to the office for copying, and clerks of all courts to which certified copies had been sent were asked to do the same. No burned patent was valid and enforceable until it was restored. The Commissioners decided which burned models were most valuable and interesting, and had them rebuilt from available records. In conjunction with the Patent Act of July 4, 1836, patents were numbered with Patent No. 1 issued on July 13, 1836. The Name and Date Patents were subsequently numbered with an X suffix added to distinguish them from the new patents. How many of them were scale-related?

Table 1. SCALE-RELATED X-PATENTS BY DATE OF ISSUE

Number	Date	Inventor	Residence	Subject
234x	Feb 14, 1799	B Dearborn	Boston, MA	vibrating steelyard (first known US scale patent)
2041x	Jan 6, 1814.	Z Phinney	Greene Co., NY	pendulum scale with 2 fulcrums
3089x	Mar 24, 1819	B Dearborn	Boston, MA	repeat of 234x, with improvements
	Mar 24, 1819	B Dearborn	Boston, MA	not seen
6573x	June 13, 1831 [1]	E & T Fairbanks	St. Johnsbury, VT	poise for zeroing wagon platform scale
6941x	Feb. 21, 1842 [1]	E & T Fairbanbks	St. Johnsbury, VT	shape of lever & support for bearings under platform
7225x	Sep. 22, 1832	E & T Fairbanks	St. Johnsbury, VT	improved Dearborn steelyard for wg loaded wagons
7371x	Jan 14, 1833	I Gay		lever design under platform
7425x	Feb 13, 1833	B Morrison	Milton, PA	schickert's principle counter scale
	Feb 21, 1832 [1]	E & T Fairbanks	St. Johnbury, VT	not seen
7432x	Feb 19, 1833	J B Maag	New York, NY	mobile platform scale
8046x	Mar 6, 1834 [1]	E & T Fairbanks	St. Johnsbury, VT	bearings under platform
	Mar 6, 1834 [1]	E & T Fairbanks	St. Johnsbury, VT	compound levers on cart & counter scale
8543x	Dec 17, 1834	T Potter, Sr.	Warren Co., KY	steelyard & crane combined
8794x	Apr 22, 1835	J B Maag	New York, NY	platform scale (assigned to J G Rohr)
8847x	May 29, 1835	E A & A Hibbard	Lunenburgh, VT	platform steelyard
9077x	Sept 9, 1835	J Marden	Baltimore, MD	arrestment for platform sc used in railway depot
9231x	Nov 7, 1835	E A Hibbard	Lunenburgh, VT	counter steelyard
9,644x	May 17, 1836	C P Ladd	.....burgh, VT	lever design for counter platform sc
9678x	May 23, 18362	J M Peck	Lyndon, VT	counter platform steelyard
9878x	July 2,18362	J Horton	Madrid, NY	cart weighing platform scale

1. These Fairbanks scale-related patents were revised and re-issued on Feb. 10, 1837, under Letters Patent numbers 118, 119, 120, 121, 122, 123, 124, with some of the earlier patents sub-divided into more than one fresh patent.

What did those early American scales look like? Where are those drawings?

Until recently, no one seemed to know. The Subject-Matter Index of all the US Patents issued between 1790 and 1873 does not include any scales from the pre-1836 time period. But thanks

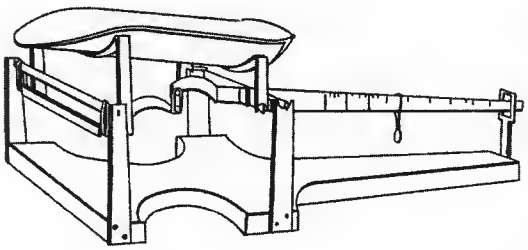


Fig. 2. ≺≺ Hibbard's patent 9231X of Nov 7 1835 for the first US top-pan counter steelyard, with 2' 6" beam. Text illegible.

largely to the persistence of researcher Jim Davie,[1] and the sharp eyes of the late George Mallis,[2] the picture is becoming much clearer.

Of the drawings destroyed in 1836, only about 2,845 could be restored/reconstructed. It is not clear how much liberty the artists exercised when making the reconstructions. The reconstructions may reflect the style of the 1840s rather than the original styles. The restored X-Patent drawings can be seen at the National Archves, and reproductions of them are now displayed in the PTO.

Table 1 lists the scale-related X-Patents currently available. Persons having internet capability can download them at http://www.uspto.gov. Anyone can order complete patents for $3.00 postpaid from Copy Fulfillment, USPTO, Washington D.C. 20231, phone 703 308-9726, or fax 703 308-9759.

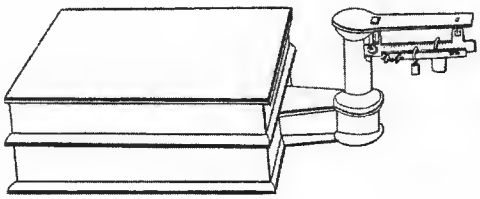
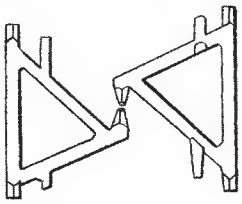


Fig. 3a & 3b. ≺≻ Peck's patent 9678X of May 23 1836 for a counter platform scale with novel leverage. This appears to be the first example of a platform scale small enough to go on a counter.



1 Davie, J, "Guide to Historical Research in the PTO," 1997; "Early Patent Drawings," 1997; *Archives Numerical* 2000,Congressional and National Archives records, Correspondence 1994-2001.

2 Mallis, G, photocopies of documentation about Benjamin Dearborn and his scales, including the missing drawings of patent 3089x.

First US Scale Patentee

BY D F CRAWFORTH-HITCHINS

Benjamin Dearborn was a notable figure in Boston in the late 18th century, vigorous in patenting his ideas, and in promoting the use of his scales. He made scales for the rough end of the trade, for weighing canons and loaded wagons; for the thriving middle of the trade, the shop-keepers; and for the refined end of the trade, the mints and banks. Not all our knowledge of him comes from patents, but the patents give a good start.

Patent 3089X is verbose in the extreme. Dearborn took 17 pages to describe the minutiae of making his steelyard with its frame and accessories. To abbreviate, he stated that his original patent of Feb 14, 1799, was for a *vibrating steelyard* with graduations on both sides of the blade, for the big poise (normally a cased brass poise of 16lb) and for the small poise (normally of 2lb). By adding together the weight indicated on both sides, when both poises were in use at the same

time, the total weight was derived. Fig. 1. The steelyard vibrated because the load end of the beam exactly balanced the mass of the blade before any poise was added.

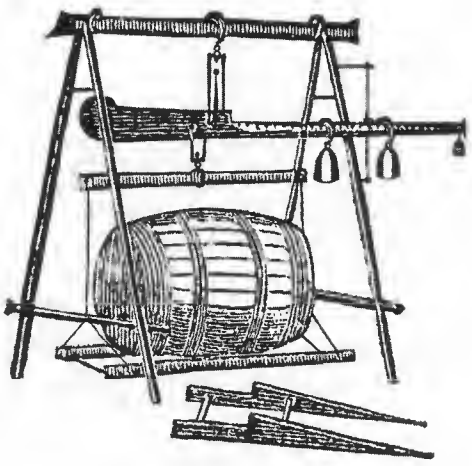


Fig. 1. ⩓⩓ Dearborn's patent of Feb 14 1799.

He improved his protection in March 24, 1819 by additions to patent 3089. The 1st change was for his curved-up load-end, to raise the centre of gravity. The 2nd change was the addition of a second load-hook further away from the fulcrum to enable the weighing of lighter loads. 1lb loaded on the hook balanced the light poise at 10lbs, (and the user had to remember to divide by ten!) Alternatively the light pivot-point was at 16 times the distance from the fulcrum, so that a load read off at, say, 20lb, weighed 20oz. This second suggestion seems more satisfactory.

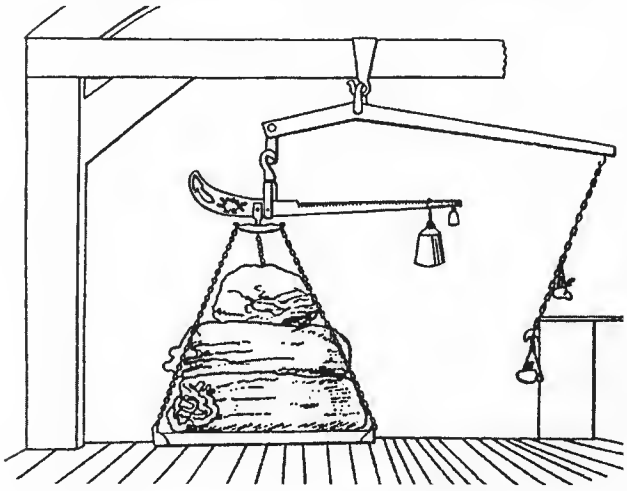


Fig. 2. ⩓⩓ Showing Dearborn's 1819 changes 1, 4, and 5.

The 3rd change was the addition of little poises called 'grosses' hung from the big poises. These grosses were 12% of the mass of their bigger poises, so an allowance was made for wastage of 12lb on every 100lb. The 4th change was the addition of a tare weight hung on the end of the blade when a scale-pan was hung from the load hook so that the steelyard still vibrated.

The 5th change was for a lever to lift the loaded steelyard free of the ground without effort. A chain hung from the long end of the lever, with handles down its length, by which the operator heaved on the chain. It seems inconceivable to us that he could patent a lever. Was he really trying to? The 6th change was another variant of the lever but used for outdoor weighing.

The 7th change was for the frame from which the steelyard was suspended for outdoor weighing. The 8th change was the guard on the frame that prevented the blade from rising or falling too far, using a roller above and a flat spring below to prevent the steelyard from jolting.

The 9th change was for sliding can-hooks to lift hogsheads, with 2 hooks pulling shut as the load rose, as used by stone-masons. The 10th change was for his folding platform, used to hold exceptionally bulky loads. The 11th change was for cotton-hooks, with 4 hooks tightening as the bale rose. The12th change was a flat platform strong enough to take sugar boxes of about 500lbs, and a chair to turn the steelyard into a person-weighing machine. Was he really *patenting* all these changes? Or was he just *describing* the new features of his steelyard? It beggars belief that he could be allowed to patent these long-used tools of the trade, and one imagines violent expletives from any scale-maker reading the patent. Did any scalemaker complain

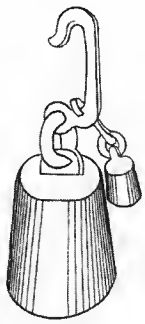


Fig. 3 ⩓⩓ Change 3.

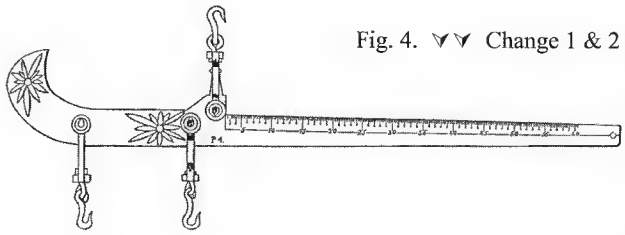


Fig. 4. ⩛⩛ Change 1 & 2

that these items were in current use and thus not available for patent-protection? So which of these changes *was* Dearborn patenting?

The drawings for this patent were not found in the Patent Office. The late George Mallis found them elsewhere, but they are clearly labeled with the correct date for patent 3089X. They give an immediate idea of how his steelyard worked in 1819, and never was the truism more accurate, "a drawing is worth a thousand words".

In December 1802, he was still making his simple steelyard with more than one poise, and using wedges to roll hogsheads up onto the platform (no can-hooks!). He wrote a petition pointing out that he had first requested that the Councils of Philadelphia permit the use in their markets of his Patent Steelyard in March 19, 1799. It was refused because of serious doubts about steelyards as honest scales. The Legislature of Massachusetts had accepted Dearborn's steelyard after they were assured that the mathematics were accurate, and so had almost every other state of the Union. It was used in the market in Washington DC, by Customs-houses, and by the government to weigh cannons. This extreme pressure by Dearborn to get his steelyard accepted for trade use was to have far-reaching effects when Fairbanks introduced their platform steelyards and Peck his counter steelyard for trade use. Dearborn was thus a pioneer of great importance to the US.

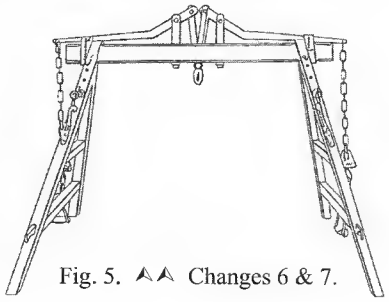


Fig. 5. ⩓⩓ Changes 6 & 7.

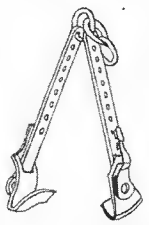


Fig. 6. ⩓⩓ Change 9.

Dearborn derided the "common steelyard" on the grounds that the knife-edges were in a line, so that the bearing tips were not in a line, making the steelyard fast when weighing light loads, and even faster when turned over to weigh heavier loads. (See EQM, pages 1543 and 1544.) It seems surprising that steelyards were still made in that way in 1802. He averred that a 56lb weight tested on his 20-year-old steelyard were as accurately tested as that same weight weighed on the City Balance, an equal-arm balance! He said "If the Patent Balance had been an invention before known and used, government would not have granted a Patent for it." Disingenuous?

He compared his properly-aligned knives with the old way of knocking them in, shown in Dobson's Edinburgh Encyclopaedia of 1797, and affirmed that he showed his modern alignment to a gentleman in 1783. He sneered at the steelyard shown in the book because it was a conventional turn-over steelyard with a limited capacity, pointing out that his 3000lbs-capacity steelyard used three poises of 32lbs, and one of 16lbs, which were easily handled, and could weigh a minimum load of a mere 1lb. This use of four combined poises was truly original, very practical and should have formed the centre of his patent, yet he points it out only in a petition to score points off a drawing of a steelyard shown in one obscure Encyclopaedia!

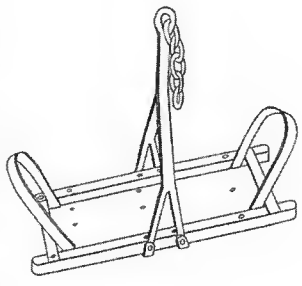


Fig. 7. ⩓⩓ Change 10.

Dearborn wrote of his tare-poise for the scale-pan, so this idea, patented in 1819, was in use for at least 16 years before he patented it. He lauded

his brass-cased poises, and said that his steelyard for weighing hogsheads cost only half as much as an equal-arm beam bought in Boston for the same purpose. The latter needed many weights to balance 20cwt, whereas his steelyard needed only 3 poises, 3 grosses and 1 tare poise, so his steelyard needed only one man with a hand-cart to transport it, or 2 men, if hogsheads were to be weighed.

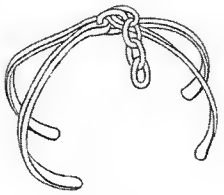


Fig. 8. ⅄⅄ Change 11.

Dearborn stated that "A considerable proportion of the small meat sold in the market is taken by the purchaser without seeing it weighed because but few come accommodated with scales and weights." If his Balance were to be adopted, those traders would find a steelyard practical to carry and use.

In 1804 Dearborn published a justification of his Proportional Balance, (he re-named it), with an important footnote, that his instrument has been authorised by an Act of the General Council, "for use in all cases of weighing throughout this Commonwealth. This Act secures to the purchaser the Stamp of a Sworn Sealer on every beam and its weights". (No mention of what class of goods were to be weighed on his instrument!) He had got his steelyard fully accepted!

He described his proportional balance as having two poises, one always 2, 4 or 8 times as heavy as the smaller poise. Every beam had, near where the numbers start on the blade, a stamp impressed into each side of the beam designating what poise belonged to each side. If extra poises were required they are always multiples of the heavier poise, and the beam was stamped, say, *2 P 32*, or *3 P 32*, this latter meaning *3 Poises of 32lb*. Beams weighing only in ounces could be supplied if desired.

Fig. 9. ⅄⅄ Dearborn's Gold Standard Balance, possibly made as early as 1801. Courtesy Harvard University

If it proved difficult to lift the heavier poises along the beam, a chain could be supplied hanging from the hook on the blade, sufficiently long to let the poise rest on the ground. He did not explain how the weight of the chain was taken into account, but the catalogue (discussed below) made it clear that poises supplied with a chain were of different [lighter] weight from those used directly on the beam. He said "By late improvements in the apparatus, the largest hogsheads are now taken up and weighed without being rolled from their station". Can-hooks by 1804?

Dearborn published a description of his Gold Standard Balance in 1801. The Boston Gazette of July 2 1804 had his advertisement for *Gold Standard Balances for Banks, and Hydrostatic Balances for detecting Counterfeit Coins, both constructed upon a different application of*

principles to any thing of the kind heretofore known. In Nov. 1817 Dearborn described his Gold Balance with "four different denominations ... the higher style [and the second] for weighing five thousand dollars at a draft ... has now survived the scrutiny of fifteen years, in which time it has been adopted by all the Banks in Boston and many others in the US". This handsome design had fine adjustments that were far in advance of those on other Bank scales used in US and UK at that time. (See *Directions for use of the Gold Standard Balance* that Dcarborn first published in 1817, in EQM 1211-1212.) Could an up-dated version of this beautiful balance be the subject of his second 1819 patent? Or could that patent cover the hydrostatic balance, as yet unidentified?

Having trawled through the verbose descriptions and justifications, it comes as a relief to read his undated catalogue. He listed 50 sizes available, with their various apparatus, from small beams below 100lb capacity to beams for weighing 10,000lb or more, available on demand. The beams up to 1400lb needed only two poises, but the larger beams were supplied with three poises. He supplied poises in American, French or Dutch units, and supplied all the items mentioned in the 1819 patent, each at a particular price for the size of beam they fitted.

He sold "beams with a scale-platform to hold the Carriage with its load" He also sold "Balanced Platforms ... for driving Loaded Carriages on and weighing them accurately, without suspending them from above." What was he writing about? Pre-Fairbanks platform scales? Just this once, he should have been more detailed! Oh, for a time-machine to visit this dynamic man at his shop near the Western End at the Theatre, Boston!

The date of Dearborn's death is not known, but his influence and skill was ably maintained by his clerk, Henry Plympton, who stated in 1828 (EQM, 1215) that he was successor to Dearborn at Boston Quay. He certainly continued to sell the bank scales, and taught what he knew to his apprentices Edward Howard and David P Davis - Howard & Davis, worthy successors!

Showcase

Next page Top. French counter béranger scale, marked CT; (Charles Testut of Paris registered this mark in the 1880s). Capacity 15 kilos. Presumed to be for a smart butcher's shop. Collection R Van Nieuwerburgh.

Middle left. English candlestick postal scale of white glass with gilded numbers and scrolls, and brass collars and working parts. Stamped round the letter plate R W WINFIELD, BIRMINGHAM, REGISTERED SEPT. 5TH, 1848. 7¼ins (180mm) high. Postal rates for 1840-1871. Collection B Stein.

Middle. American Selector postal scale. Half roberval and spring. Collection B Stein.

Middle right. English candlestick postal scale of green glass with gilded brass tube and gilded letter plate. Impressed into brass collar R W WINFIELD BIRMINGHAM. 7¼ ins (180mm) high. The most ornate of the various glass candlesticks. Postal rates for 1840-1871. Photograph by L uit den Boogaard.

Bottom left. English postal scale of Chinese style. Brass cloisonné with turquoise enamel. Small areas of royal blue, pink, gold and brown. Marked S MORDAN & Co, LONDON. 8ins (200mm) wide. Collection B Stein.

Bottom right. English poises for testing the accuracy of egg-sorting machines in packing stations. Supplied to the inspector of W & M by his local authority. Brass plate on lid engraved 'BEN NEVIS' / EGG-GRADING MACHINE TEST POISES / SOLIHULL COUNTY BOROUGH / BEN-NEVIS EGG EQUIPMENT LTD / TROWBRIDGE, WILTSHIRE. Mahogany box 9¾ins wide, lined with thick green baize. The bright red heaviest poise labelled AA checked the 2³/16oz gate, being ¼ dram over the correct weight. The black poise AR checked the same gate, being ¼ dram below the full weight. The black poise BA and the green poise BR checked the 1⁷/8oz gate. The green poise CA and the pale blue poise CR checked the 1⁵/8oz gate. The pale blue poise DA and the donkey brown poise DR checked the 1½oz gate. Made of plastic, with a mass inside one end of the 'egg' to simulate the eccentric mass of real eggs. Photograph by D Crawforth-Hitchins.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